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# THE PHILIPPINE JOURNAL OF SCIENCE

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THE ILOKO KITCHEN

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In this paper we shall give a list of the Iloko terms most generally used in or with reference to the kitchen. We shall first give the substantives which contain a verbal particle, and afterwards the complete list, in which, however, Spanish terms will not be included.

SUBSTANTIVES INCLUDING VERBAL PARTICLES

The Iloko are quite consistent and use the forms of the present and those of the past as they should be used. This statement may seem very strange, but let us explain.

A substantive denoting a kind of food is not supposed to have either a present or a past form; but, as we have stated above, some of these substantives include verbal particles which have these two forms. Now the Iloko will use a verbal particle in the present form, whenever it accompanies a stem, which indicates an action that has TO BE performed, and one in the past form, whenever it accompanies a stem, which indicates an action that has BEEN performed. Let us come to the examples.

Both "ti kanén" and "ti inapúy" mean: the rice, and both are used as simple substantives. You can say that you eat "ti kanén" and "ti inapúy," and you can say as well that you ate "ti kanén" and "ti inapúy." However, "kanén" includes a substantival suffix in the present form (suffix EN), and "inapúy" includes the same in its past form (infix IN); and the reason is that "kanén" is derived from the stem "kan" (eating), an action that has TO BE performed after the object indicated by the whole substantive (*kanén*) is ready, while "inapúy" is derived from the stem "apúy" (fire), an action (the action of

the fire) that has BEEN performed when the object indicated by the whole substantive (*inapúy*) is ready.

It is true that "kanén" is also a verb meaning: to eat, and "apuyén" (the present form of *inapúy*) a verb meaning: to cook, and that both verbs have a form for the past tense, but that is not to the point, as we are talking about words that are used as simple substantives. We shall see more of these in the list that follows.

The three verbal particles used in the formation of these substantives are—

1. The substantival suffix EN (past: infix IN), which conveys the notion of a simple action.
2. The substantival suffix AN (past: infix IN and suffix AN), which conveys the notion of a locative.
3. The substantival prefix I (past: prefix IN), which conveys the notion of an instrumental.

All of them retain their original notion in the substantives we are talking about. We shall now explain one example for each of the three; the others will be seen in the course of this paper.

1. *Kinirúg,* from the stem *kirúg* (roasting) and the infix IN (past form): a dish consisting of something that has been roasted (simple action).
2. *Dinanumán,* from the stem *danúm* (water) and the infix IN combined with the suffix AN (past form): a dish consisting of something that has been cooked in water (locative).
3. *Indadáñg,* from the stem *dadáñg* (warming) and the prefix IN (past form): a dish consisting of something that has been warmed, with which the action of warming has taken place (instrumental).

The prefix PA, which indicates order, permission, causing to happen, etc., is often combined with these particles into PINA (past form of PA . . . EN), PINA . . . AN (past form of PA . . . AN) and INPA (past form of IPA). This will be seen in some of the examples that follow.

SUFFIX EN

ammaráy(en). Cold cooked rice, dried in the sun.

(in)añgér. Boiled food. Vegetables, fish, and, more especially, meat that have undergone no other preparation than that of having been boiled in water.

(in)apúy. Rice, cooked rice; the staple food of the Iloko. From the stem *apúy,* fire. "To cook" is *lutoén,* from *lúto,* cooking in general; "to cook rice" is *apuyén, agapúy.* Uncooked rice is *bagás,* unhusked rice *págay.*

(pina)blád. Dry corn cooked in water until it becomes mealy. From the syncopated stem *belläd*, becoming mealy, swelling (of rice). The prefix PA means: causing to happen.

b(in)on̄gón. Any article of food wrapped in leaves, either of bananas or of palm trees, for example: cooked rice, fried meat, *sinúman*-pudding, etc. *Bon̄gón* means: wrapping, package.

b(in)utáy. Rice, either ground or pounded into powder. It is never as fine as wheat flour.

d(in)en̄gdén̄g. A dish consisting of fish or vegetables or both cooked in water, seasoned with salt and sometimes with onions, *piás* (*Averrhoa bilimbi*), etc., and served with their juice. The commonest ingredients are vegetables and *boggóon̄g* (preserved fish).

(do)dom(én). Immature rice, roasted before it is pounded. From the stem *doóm*, eating raw, immature rice. Cfr. *(in)irúb-(an)*.

g(in)úlay. A dish consisting of vegetables cooked in water, and seasoned with vinegar and raw tomatoes. The vegetables are: leaves and fruits of the cowpea, leaves of the camote, or sweet potato, flowers of the *katúday* (*Sesbania grandiflora*), etc.; not: flowers of the squash, etc.

inum(én). Beverage, drink. For example: wine, beer, gin, coffee, tea, etc.; more especially: water.

k(in)altí. Camotes, or sweet potatoes, unripe papayas, unripe bananas, etc., cut into slices and cooked in sugar.

kan(én). Rice, bread. Staple food, as opposed to meat, fish, vegetables, etc., which are called *sidá*. From the stem *kan* or *kaán*, eating.

(kan)kan(én). Sweet, bread, biscuit, cake, pudding, etc. Anything made of flour, and all sweets or desserts in which rice is the principal ingredient. Desserts in which eggs, milk, etc., are the chief ingredients are called by the Spanish term: *dulce*, sweet. From *kanén;* the reduplication adds the notion of similarity to the original term. *Kankanén* means literally: something resembling the *kanén* (rice, bread), something having one or more characteristics of the *kanén*, but not the real *kanén*.

(pina)kbét. A dish consisting of all kinds of vegetables (chiefly egg plant and *pariá* or *Momordica charantia*), mixed with meat, fish (often *boggóong*), or both, and seasoned with tomatoes, onions, lard, etc. All ingredients are cooked together. From the stem *kebbét*, crumpling.

k(in)elnát. A dish consisting of underdone, boiled meat.

k(in)irúg. Roasted coffee, popped corn, popped and unhusked *díket*-rice (a kind of very oily rice), etc. From the stem *kirúg*, roasting.

l(in)amáw. Killed hogs, chickens, etc., on which boiling water is poured to facilitate scraping off the hair or pulling out the feathers.

(pina)ltáw. A sweet consisting of *díket*-rice (a kind of very oily rice), either ground or pounded into powder, kneaded into the form of short sausages, and cooked in sugar and water. From the stem *lettáw*, appearing.

l(in)in̄gtá. Fish, eggs, vegetables, etc., cooked in water; not: meat. Cfr. *(in)an̄gér*.

l(in)úgaw. Rice porridge. Rice cooked in more than the ordinary amount of water.

p(in)áis. Thin biscuits of various colors and shapes, made of rice, either ground or pounded into

powder, and water. The dough, which is very thin, is poured out on banana leaves and cooked in a pan; then the leaves are taken off and the biscuits are exposed to the sun for a couple of days, after which they are fried in lard or coconut oil. These biscuits, which are quite insipid, are colored indigo, red, brown, yellow, green, etc., by adding dyeing matter to the dough. The green color is obtained from the leaves of the camote, or sweet potato; the indigo color from the indigo plant; the red color from the seeds of the annatto tree (Spanish *achuete* or *achiote;* American Indian *achiotl*).

p(in)akáti. Strong infusion obtained by boiling leaves, flowers, etc., in water for a long time. This is used only for medicinal purposes.

p(in)ekkél. A handful of cooked *díket*-rice (a kind of very oily rice), either ground or pounded into powder, fried in lard or coconut oil, after which melted sugar is poured over it. *Pinekkél* also means simply: a handful of rice.

p(in)uyó. A kind of rather consistent, flat cake, usually either oblong or round, made of rice, either ground or pounded into powder, water, and sugar; it is fried in lard or in coconut oil. *Puyó* means: swelling up.

s(in)alapósop. A kind of pudding, either soft or more or less hard, made of rice that has been pounded to pieces (not powder), water, sugar, and coconut meat. It is cooked in a section of bamboo, which is placed on a strainer over an earthenware jar, in which water is kept boiling. *Salapósop* means: vapor bath.

s(in)an̄gláw. A dish consisting of small pieces of beef, mutton, etc. (not: pork, chicken, etc.), cooked in water, to which a small amount of vinegar has been added.

s(in)igán̄g. A dish consisting of fish and camotes, or sweet potatoes, cooked in water and seasoned with sour ingredients, for example: *piás* (*Averrhoa bilimbi*), fruits of the tamarind, etc.

s(in)ísi. Lard, rendered fat of swine, commonly called *manteca* (Spanish). The process of extracting the lard by frying is called: *sisién.*

s(in)úman. A kind of soft pudding made of *díket*-rice (a kind of very oily rice), sugar, and *gettá* (obtained from coconut meat). It is cooked in the pan and eaten with a spoon or fork. It is very often preserved in banana leaves, in which case each preserved part takes the shape of a sausage.

t(in)adtád. Fish cut into pieces, minced meat, chopped vegetables, etc. From the stem *tadtád,* cutting into pieces.

t(in)ápay. Baked dough, for example: bread, biscuits, etc. Cfr. (*kan*) *kanén.*

t(in)iklád. Slices of camotes, or sweet potatoes, taro rhizomes, etc., dried in the sun and then cooked in water and stirred until they become mushy.

t(in)óla. A dish consisting of chicken cut into pieces and small pieces of unripe papayas, cooked together and served with the broth. This is the commonest first dish at banquets and special dinners. *Tóla* means: depreciating something in order to drive away competitors.

t(in)on̄gbó. A kind of sweet consisting of rice, either ground or pounded into powder, and sugar, cooked in joints of young *bólo*-bamboo (*Schizostachyum mucronatum*) exposed to an open fire.

t(in)úno. Broiled or roasted meat, fish, etc., toasted bread, etc. It is stuck on a piece of bamboo or wire and held over live coals. Cfr. (*in*) *pugpúg.*

SUFFIX AN

(in)asin(án). Any kind of salted food. *Asín* means: salt.

b(in)ubúd(an). A kind of milky, rather sweet, alcoholic beverage, obtained from rice. To prepare it the Iloko mix some yeast or *búbud* with a certain amount of cooked rice; then they place the rice in a jar, and after a couple of days it produces the beverage called *tápuy* or *binubúdan.* The same name is applied to the fermented rice, which is almost as highly alcoholic as the juice.

d(in)anum(án). A dish consisting of roasted (cfr. *tinúno*) fish, cooked in water and seasoned with sour ingredients, for example: *piás* (*Averrhoa bilimbi*), fruits of the tamarind, etc. From the stem *danúm,* water.

(dinar)dará(an). A dish consisting of small pieces of meat, often very fat, cooked in blood. *Dára* means: blood.

d(in)uydúy(an). A kind of sweet made of boiled ripe squash, mixed with coconut meat and either sugar or salt.

(in)irúb(an). Immature rice, roasted before it is pounded. The Iloko either eat it that way (cfr. *dodomén*) or use it instead of *díket*-rice to prepare *sinúman*-pudding. Cfr. *(in)kíwar.*

l(in)ubi(án). A kind of sweet made of *dippíg*-bananas, *díket*-rice (a kind of very oily rice), rasped coconut meat, and sugar. The bananas and the rice are cooked separately, then both are placed in the mortar together with the coconut meat and smashed with the pestle, after which sugar is added, and the whole is again thoroughly mixed with the pestle; then it is eaten with a spoon or fork.

(pinap)pait(án). A dish consisting of raw beef, mutton, etc. (not: pork, chicken, etc.), seasoned with *pápait* (thick juice obtained from the bowels of ruminants). From the stem *paít,* bitterness.

p(in)espes(án). A dish consisting of raw beef, mutton, etc. (not: pork, chicken, etc.), seasoned with food eaten by ruminants and taken out of their stomach. *Pespés* means: pressing out.

pippi(án). A dish consisting of meat and rice cooked in banana leaves. The Iloko first roast rice (cfr. *kinirúg*) and then smash it in the mortar (cfr. *lebbekén*); at the same time they cook meat seasoned with *piás* (*Averrhoa bilimbi*), and then wrap portions of meat and rice in banana leaves in the same way as *sinúman latík* is wrapped. These packages are cooked in water.

PREFIX I

(inpa)burék. Boiled water. *Burék* means: boiling.

(in)dadáñg. Rewarmed food (*sidá* or *inapúy*), water, etc.

(in)damdám. *Túpig,* camotes, yams, etc., baked in hot ashes.

(inpa)ksét. Rice, meat, etc., exposed to the action of fire until they get scorched. From the stem *kessét,* scorching, burning.

(in)kíwar. A kind of pudding prepared in the same way as *sinúman,* except the *díket*-rice, which is replaced by *dodomén* (immature rice roasted before it is pounded). *Kíwar* means: stirring.

(in)piálo. A sweet consisting of rice, either ground or pounded into powder (as fine as possible), water, and sugar kneaded into

balls and cooked in shards of a *burnáy* (large earthenware jar).

(in)pugpúg. Roasted or broiled meat, etc. It is placed directly on the fire, not on live coals, without any implements. Cfr. *tinúno.*

ILOKO WORDS OF COMMON USE IN THE KITCHEN

Four other particles will appear here and they need a word of explanation:

1. The verbal infix UM: an adjectival infix indicating a slighter action than the common prefix AG of neutral verbs. The latter does not occur in this list, while the former does, perhaps because a good many actions performed in the kitchen are of comparatively short duration (?).

2. The prefix NA of adjectives (past form of the adjectival prefix MA of verbs), sometimes combined with the suffix AN.

3. The prefix APAG meaning: recently, scarcely, etc.

4. The verbal infix AN indicating frequent repetition of the action.

(apag)abbát. Evaporated before it is cooked thoroughly. This is said only of rice boiled in water.

alunús(en). To eat meat, fish, vegetables, etc., any kind of *sidá,* without rice or bread.

ammaráy(en). Cfr. Suffix EN.

ampáw. A kind of sweet. *Díket*-rice (a kind of very oily rice) is ground or pounded into powder and cooked in lard until it swells and forms a hollow ball; then it is rolled in popped *díket*-rice, which has been steeped in melted sugar. *Ampáw* means also: empty shell, nut, etc.

(in)angér. Cfr. Suffix EN.

(in)apúy. Cfr. Suffix EN.

árak. Wine, gin, whisky, etc. The fermented juice of grapes and any alcoholic beverage obtained by distillation.

(in)asin(án). Cfr. Suffix AN.

(na)áta. Not cooked thoroughly. This is said of rice; but *naáta* means also: immature, unripe, etc.

(na)ati(anán). Evaporated, dried out, waterless.

badúya. A kind of rather consistent, flat cake, made of rice, either ground or pounded into powder, water, sugar, and slices of bananas (the variety called *dippíg*). It is fried in lard or in coconut oil, and, except for the bananas, its taste is the same as that of the *pinuyó.*

bagnét. Pieces of fat out of which lard has been extracted, and which have undergone no further preparation.

balikutcá. White-yellowish masses of sugar, made from the boiled sap or juice of the sugar cane, before it has become entirely hard; it is distended and contorted into masses of various shapes, generally coils or esses. At first they are hard, but soon they become brittle, and later on soft. This term is not genuine Iloko: *bali* enters the composition of several Iloko stems that imply the notion of turning, but the rest of the term *balikutcá* is probably derived from some Spanish term, perhaps panocha, ears of certain plants.

(basa)bása. Cooked rice to which water has been added, but no salt. From the stem *basá,* wetness.

The reduplication affects the place of the accent (*bása* means reading); this occurs very rarely in Iloko, although it is quite common in some other Philippine dialects.

bási. A kind of alcoholic beverage obtained from *bennál* or juice of the sugar cane. To prepare it the Iloko boil *bennál* together with bark of the Java plum or jambool, which gives the *bási* its distinctive brown color; then they pour it out into large earthen jars, adding a certain amount of yeast or *búbud,* and leave it to ferment.

bayo(én). To pound rice in the mortar (with a pestle), to husk it. In some places rice is called *bináyo,* husked, instead of *bagás.*

(pina)blád. Cfr. Suffix EN.

bennál. Sap or juice of the sugar cane obtained by crushing the latter.

bibíng̃ka. A kind of soft, flat cake, made of *díket*-rice (a kind of very oily rice), either ground or pounded into powder, sugar, and *gettá* (obtained from coconut meat). It is cooked in the same way as the *póto,* but the earthen pot used for the *bibíng̃ka* is larger than the one used for the *póto.*

boggóong̃. A kind of preserved fish, much relished by the Iloko and used to season their food, which often consists, besides rice, of otherwise tasteless vegetables. The fish (any kind, but more especially *ípon,* a kind of very small, white fish just out of the spawn, and *bilís,* a kind of sardine) is first salted (one part of salt and two of fish and water), thoroughly kneaded, and then let ferment in large earthen jars. Sometimes, before it is salted, the fish is kept a couple of days until it gets spoiled.

bokáyo. A kind of sweet made of coconut meat and sugar. It is cooked in a large earthen pan with round bottom and then usually transferred to coconut shells, where it cools and becomes hard. Sometimes it is cut into small cubes.

b(in)ong̃ón. Cfr. Suffix EN.

(na)btóor. Badly roasted. When roasting (cfr. *tinúno*) meat or fish, and the outside is scorched or burned, while the inside is still raw. From the stem *bottóor,* startling. Cfr. (*na*)*kusél.*

búbud. The yeast used in the preparation of *binubúdan* or *tápuy* and *bási.* This yeast is obtained from rice, either ground or pounded into powder, mixed with ginger and old yeast; it is laid away for two or three days and then exposed to the sun, after which it forms a kind of dry, brittle, white cake.

b(in)ubúd(an). Cfr. Suffix AN.

(inpa)burék. Cfr. Prefix I.

busí. Popped corn or *díket*-rice (a kind of very oily rice). It is very often thrown into a pan of liquefied sugar, over the fire, and then generally formed into balls.

b(in)utáy. Cfr. Suffix EN.

(in)dadáng̃. Cfr. Prefix I.

dáing̃. Salted fish dried in the sun. This term is applied to small fishes dried in their entirety. Cfr. *dalang̃dáng̃* and *tápa.*

dalang̃dáng̃. Large fishes, cut open, salted, and dried in the sun. Cfr. *dáing̃* and *tápa.*

(in)damdám. Cfr. Prefix I.

danúm. Water.

d(in)anum(án). Cfr. Suffix AN.

(dinar)dará(an). Cfr. Suffix AN.

d(in)eng̃déng̃. Cfr. Suffix EN.

digó. Juice, broth. Juice of meat, etc., and more especially: liquid in which some article of food has been boiled, for example: meat, fish, vegetables, etc., not rice (cfr. *seggét*). The same term is sometimes applied to the juice or sap of the coconut, etc.

(dila)díla. A kind of soft, flat, tongue-shaped cake, made of rice, either ground or pounded into powder, and water. It is cooked in water, and, when the cake is transferred to a plate, a small mass of rasped coconut meat and one of sugar are placed separately in front of it. *Díla* means: tongue; the reduplicated form: something resembling a tongue.

diró. Honey.

dodól. A kind of pudding, made of rice, either ground or pounded into powder, *gettá* (obtained from coconut meat), and sugar. Everything is put in a pan, first *gettá* and sugar, and then rice, and stirred while it is cooking.

(do)dom(én). Cfr. Suffix EN.

d(in)uydúy(an). Cfr. Suffix AN.

(apagan)em-ém. Beginning to get warm, but not yet boiling. This is applied to water. The stem *em-ém* means: pressing one's lips.

gátas. Milk.

gettá. The milk contained in coconut meat and obtained by pressing the latter.

gípañg. A sweet made of cooked *díket*-rice (a kind of very oily rice). The rice is dried in the sun, then fried in lard until it pops, and finally thrown into a pan of liquefied sugar, over the fire, after which it is cut into lozenge-shaped cakes.

g(in)úlay. Cfr. Suffix EN.

gúpi. A dish consisting of small pieces of meat, liver or lung, cooked in lard and vinegar.

inum(én). Cfr. Suffix EN.

(in)irúb(an). Cfr. Suffix AN.

ittíp. Crust of rice, namely: the rice that adheres to the bottom of the earthen jar in which it is cooked.

kalámay. A kind of sweet made of rice, either ground or pounded into powder, sugar, and water. It is cooked in a pan and stirred continually until it becomes thick and more or less consistent. It is eaten with a spoon and very often preserved in small coconut shells of the *makapunó*-variety: to do this the coconut is cut into halves, which are emptied, filled with *kalámay,* and put together again, a piece of colored paper being pasted all around to keep the two halves together.

kalasakós. A sweet consisting of cooked *díket*-rice, coconut meat, and sugar. After the rice has been cooked, it is pounded in a mortar, and then spread open over some hard, even surface, so as to take the appearance of a huge pancake; after this the coconut meat and the sugar are sprinkled over the cake, and the latter is cut into rectangular sections.

kallamó. Preserved fish (cfr. *boggóoñg*), which has not been in the jar long enough and has not yet fermented sufficiently.

k(in)altí. Cfr. Suffix EN.

kan(én). Cfr. Suffix EN.

(kan)kan(én). Cfr. Suffix EN.

káriñg. Cfr. *dáiñg.*

(pina)kbét. Cfr. Suffix EN.

k(in)elnát. Cfr. Suffix EN.

(inpa)ksét. Cfr. Prefix I.

kilaw(én). To eat raw (meat or fish).

(kiriñg)kiríñg. A sweet consisting of rice, either ground or pounded into powder, and sugar. It is cooked in lard or coconut oil and takes all possible forms: round, oval, ringlike, oblong, etc.

k(in)irúg. Cfr. Suffix EN.

(pa)ksíw. A dish consisting of meat or fish seasoned with vinegar and cooked in a small quantity of vinegar mixed with salt, until the liquid has evaporated. From the stem *kissíw,* convulsion, curving.

(in)kíwar. Cfr. Prefix I.

(na)kusél. Half-cooked. This may happen to rice, *sinúman*, etc., when the jar is overfull, and only the upper part is cooked thoroughly, while the rest is not. Cfr. *(na)-btóor.*

l(in)amáw. Cfr. Suffix EN.

lána. Coconut oil.

lebbek(én). To smash, to pound in the mortar (with a pestle), for example: cooked rice, bananas, roasted immature rice (*dodomén*), etc. Cfr. *bayoén.*

(pina)ltáw. Cfr. Suffix EN.

(na)línay. Cooked thoroughly, even though it be still moist. This is said only of rice. Cfr. *(apag)-abbát*, *(na)áta*, and *(na)kusél.*

l(in)iñgtá. Cfr. Suffix EN.

l(um)uág. To foam, to scum.

l(in)ubi(án). Cfr. Suffix AN.

l(in)úgaw. Cfr. Suffix EN.

luto(én). To cook (in general). Cfr. *(in)apúy.*

nípa. An alcoholic beverage obtained from the juice of the nipa palm (*Nipa fruticans*) by distillation.

ókoy. A kind of very consistent cake, made of rice, either ground or pounded into powder, chives leaves, *kúros*-shrimps, salt, and lard. It is fried in lard, harder than the *badúya* and drier than both the *badúya* and the *pinuyó.*

ópia. Soft, rather consistent cakes made of *díket*-rice (a kind of very oily rice), either ground or pounded into powder, and sugar. They are molded into different shapes, simply round or taking the form of diminutive men, horses, etc., and resemble small loaves, the lower side being flat and the upper side rounded; these cakes are hollow inside, and there sesame seeds cling to the dough; the upper side is ornamented with seeds (half black and half scarlet) of the *bugayóng* (*Abrus precatorius*), which, however, are not eaten, as they are purely ornamental.

p(in)áis. Cfr. Suffix EN.

(pinap)pait(án). Cfr. Suffix AN.

p(in)akáti. Cfr. Suffix EN.

patúpat. Cfr. *s(in)úman ípus.*

patúpat ti sinublán. A kind of soft pudding made of *díket*-rice (a kind of very oily rice) and sugar. When it is preserved it is wrapped in plaited pinnæ of palm leaves and each preserved part takes the shape of a diminutive brick. *Patúpat ti sinublán* means literally: *patúpat* of the *sinublán*, a large iron pot with rounded bottom.

p(in)ekkél. Cfr. Suffix EN.

p(in)espes(án). Cfr. Suffix AN.

(in)piálo. Cfr. Prefix I.

pippi(án). Cfr. Suffix AN.

póto. A kind of soft cake, made of rice, either ground or pounded into powder, water, sugar, and yeast, with the occasional addition of coconut meat, eggs, etc. It is cooked in a cylindrical earthenware pot with a flat bottom; the pot is covered with a piece of tin plate, and fire is applied on all sides, above, and underneath.

(in)pugpúg. Cfr. Prefix I.

p(in)uyó. Cfr. Suffix EN.

sagpáw. A dish consisting of fish and vegetables. The vegetables are cooked first, then the fish is added, either raw or cooked, and the whole is cooked again.

s(in)alapósop. Cfr. Suffix EN.

s(in)añgláw. Cfr. Suffix EN.

saramsám. Anything that is eaten, either between meals or as a dessert, for example: fruits, cakes, sweets, etc.; any kind of food that is neither *kanén* nor *sidá.*

seggét. Water in which rice has been boiled.

sidá. Any article of food that is eaten with rice, or sometimes with bread, for example: meat, fish, vegetables, etc. This term very often simply refers to fish (*ikán* in Iloko), either alive, dead, or cooked, probably on account of the preference of the Iloko for fish as *sidá.* Rice has the preëminence among all other kinds of food, therefore it is called *kanén* (food) or *inapúy* (something that has been exposed to the action of fire, or cooked food); and so also fish has the preëminence among all other kinds of *sidá,* as the Iloko sometimes refer to it simply as *sidá.*

s(in)igáñg. Cfr. Suffix EN.

s(in)ísi. Cfr. Suffix EN.

suká. Vinegar. The native vinegar is obtained by the fermentation of dilute *bási.*

s(in)úman. Cfr. Suffix EN.

s(in)úman ípus. A kind of soft pudding made of *díket*-rice (a kind of very oily rice), *gettá,* obtained from coconut meat, and salt. It is preserved in banana leaves, each preserved part taking the shape of a cone. *Ipus* means: tail.

s(in)úman latík. The same as the preceding, except that no *gettá* is mixed with it, that the vender gives you sugar and rasped coconut meat when you buy it, and that the cones are flattened when it is rolled up in banana leaves.

t(in)adtád. Cfr. Suffix EN.

tagapulót. Sugar. It consists of the sap or juice extracted from sugar cane by crushing the latter, and then boiled. The *tagapulót* is either a dark brown, siruplike liquid (*patároy*), a yellow or brown powder (*burisañgsáñg*), or a dark brown hard substance in the form of a small, much flattened hemisphere (*tinípay*). Refined, white sugar is called by the Spanish terms *azúcar* or *refinado.*

tamális. A dish consisting of any kind of small fish (*ípon, bagsét, taliboknó, monámon,* etc.), seasoned with vinegar, salt, and ginger, wrapped in banana leaves in the same way as the *sinúman latík,* and cooked in a small amount of water.

tápa. Thin slices of meat, salted, occasionaly dipped in vinegar, and dried in the sun. Cfr. *dáiñg* and *dalañgdáñg.*

t(in)ápay. Cfr. Suffix EN.

tápuy. Cfr. *b(in)ubúd(an).*

t(in)iklád. Cfr. Suffix EN.

t(in)óla. Cfr. Suffix EN.

t(in)oñgbó. Cfr. Suffix EN.

tubá. The sap of the buri palm (*Corypha elata*) obtained by cutting off its terminal bud, or cabbage.

t(in)úno. Cfr. Suffix EN.

túpig. A kind of sweet made of rice, either ground or pounded into powder, and sugar; the dough is rolled up in banana leaves, into the form of sausages, and placed in the oven or in hot ashes.

ugáda. A dish consisting of slices of young bamboo shoots and *boggóoñg* (preserved fish), cooked in the juice of rasped coconut meat that has been kneaded, with the addition of a little water.

EXTRACT FROM SILKWORM PUPÆ: A USEFUL SUBSTITUTE FOR MEAT EXTRACT IN THE PREPARATION OF BACTERIOLOGIC CULTURE MEDIA.

By Minoru Nukada

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In a previous communication(1) the writer announced the usefulness of ordinary culture media in which the meat extract or the meat infusion, as usually employed, has been substituted by material that is easily obtainable in nature at practically no cost. During the process of raw-silk production the killed silkworm pupæ accumulate as refuse. As Japan is a leading country in silk production, this material is available in this country in unlimited quantities even in the remotest parts. Useful disposal of this refuse of Japan's main home industry has been found in utilizing it as fertilizer, as feed in poultry raising, and in fish culture.

The high content in protein matter of the pupæ, the convenience with which it can be obtained, and its extreme cheapness have suggested to the writer the investigation already mentioned,(1) with the view to ascertain the usefulness of dead silkworm pupæ as a substitute for meat in the preparation of culture media for bacteriologic purposes. Early experiments have pointed out that, in addition to the advantage of an economic nature, this culture medium may leave nothing to be desired when compared with media prepared of meat extract.

Since the time of our early experiments (1930) further experiences have accumulated and prompted the publication of this final report.

CHEMICAL COMPOSITION OF SILKWORM PUPÆ

The chemical composition of silkworm pupæ has been determined by Oshima,(3) as given in Table 1.

Some differences in chemical composition were found with various species. Even with the same species variations in the chemical composition were found when silkworm crops of different seasons of the year were analyzed. These specific and seasonal variations, however, in no way influenced their usefulness for the culture media.

TABLE 1.—*Chemical constituents of silkworm pupæ (Harugo).*[a]

	Per cent.	Per cent.
Dry matter	33.48	100.00
Crude ash	1.38	4.13
Ether extract	10.59	31.62
Total nitrogen	2.95	8.82
Protein N	2.61	7.89
Nonprotein N	0.34	0.93
Insoluble N	2.52	7.54
Soluble N	0.43	1.28
Protein N	0.09	0.25
Basic N	0.08	0.23
Ammonia N	0.01	0.02
Chitin N	0.10	0.30
Chitin N plus chorionin N	0.15	0.45
Quality of oil:		
Acid value	10.65	
Iodine value	87.08	

[a] From Oshima, S., Report Imp. Fisheries Inst. 23: 145.

Thus the spring crops (Harugo) were found to have the highest food value, the autumn crops (Akigo) being next but still superior to the food value of the silkworm pupæ gathered in summer (Natsugo). Table 1.)

PREPARATION OF THE PUPÆ MATERIAL FOR CULTURE MEDIA

The dead pupæ are air- and sun-dried until they can be easily crushed between the fingers. They are then ground into a dry fine powder.

PREPARATION OF THE MEDIA

LIQUID EXTRACT OF THE PUPÆ MATERIAL

To 1 liter of tap water 100 grams of dried ground pupæ material is added. This suspension is boiled one hour and left in a steam sterilizer for one hour. It is then filtered through paper. Thus a clear yellowish brown liquid extract is obtained, from which the usual liquid or solid medium can be prepared.

In order to determine the most suitable concentration of the three important constituents of ordinary culture media—namely, the extract, the peptone, and the sodium chloride—the following experiments were performed.

Search for a suitable concentration of pupæ extract (Table 2).—Four concentrations of the extract were employed in the strength of 50, 25, 10, and 5 per cent. To these 1.5 per cent of agar was added. From the results of the test (Table 2) it is evident that the lowest concentration that gave satisfactory

growth of the bacteria tested was 10 per cent. In these experiments the culture medium contained only pupæ extract and agar and the reaction was adjusted to pH 7.2.

TABLE 2.—*Results of tests made with the view to determine the suitable concentrations of pupæ material.*

[Incubated twelve hours at 37° C.; +, growth; —, no growth.]

Species of bacteria employed.	Concentration of pupæ.					
	70 per cent.	50 per cent.	25 per cent.	10 per cent.	5 per cent.	Control.
Bacillus typhosus	—	—	+	+	+	+
Bacillus paratyphosus A	—	—	+	+	—	+
Bacillus paratyphosus B	—	+	+	+	+	+
Bacillus coli communis	+	+	+	+	+	+
Bacillus dysenteriæ Shiga	—	—	+	+	+	+
Bacillus dysenteriæ Flexner	—	+	+	+	+	+
Bacillus dysenteriæ Y	—	—	+	+	—	+
Staphylococcus citreus	+	+	+	+	+	+
Staphylococcus aureus	+	+	+	+	+	+
Staphylococcus albus	+	+	+	+	+	+

TABLE 3.—*Results of tests made with the view to determine the suitable concentrations of sodium chloride (10 per cent pupæ).*

Species of bacteria employed.	Concentration of sodium chloride (NaCl).				
	None.	0.25 per cent.	0.5 per cent.	1.0 per cent.	Control.
Bacillus typhosus	++	++	+++	++	+++
Bacillus paratyphosus A	++	++	+++	++	+++
Bacillus paratyphosus B	++	+++	+++	++	+++
Bacillus coli communis	+++	+++	+++	++	+++
Bacillus dysenteriæ Shiga	++	+++	+++	—	+++
Bacillus dysenteriæ Flexner	++	++	+++	++	+++
Bacillus dysenteriæ Y	++	++	+++	++	+++
Staphylococcus citreus	+++	+++	+++	++	+++
Staphylococcus aureus	+++	++	+++	++	+++
Staphylococcus albus	+++	+++	+++	++	+++

Search for a suitable concentration of sodium chloride (NaCl) (Table 3).—In this test the concentration of the extract was maintained constant at 10 per cent, and the amount of salt was varied from 0.25 to 1 per cent.

Two kinds of controls were included in this test—namely, one containing pupæ extract only and no salt, while an ordinary meat extract-peptone-salt medium was used also for comparison.

The result of this test showed that the bacteria employed grow on the pupæ-extract media, which contained 0.5 per cent NaCl

better than without salt, but almost just as well as on the ordinary meat-extract media containing besides 0.5 per cent NaCl also peptone.

Search for a suitable concentration of peptone (*Table 4*).—In this test the concentration of pupæ extract and that of NaCl remained constant and the peptone content was varied.

TABLE 4.—*Results of tests made to determine the suitable concentration of peptone* (*10 per cent pupæ*).

Species of bacteria.	Concentration of peptone. 0.5 per cent.	0.75 per cent.	1.0 per cent.	2.0 per cent.	Contrast.	None.
Bacillus typhosus	+++	+++	+++	+++	+++	++
Bacillus paratyphosus A	+++	+++	+++	+++	+++	++
Bacillus paratyphosus B	+++	+++	+++	+++	+++	+++
Bacillus coli communis	+++	+++	+++	+++	+++	+++
Bacillus dysenteriæ Shiga	+++	+++	+++	+++	+++	++
Bacillus dysenteriæ Flexner	+++	+++	+++	+++	+++	++
Bacillus dysenteriæ Y	+++	+++	+++	+++	+++	++
Staphylococcus citreus	+++	+++	+++	+++	+++	+++
Staphylococcus aureus	+++	+++	+++	+++	+++	+++
Staphylococcus albus	+++	+++	+++	+++	+++	+++

Four concentrations of peptone were made; namely, 0.5, 0.75, 1, and 2 per cent. One control medium contained pupæ extract (10 per cent) only, and the other one was the usual ordinary meat-extract medium containing peptone and salt.

TABLE 5.—*Correlations of the concentration of materials.*

	Tap water.	Pupæ.	Peptone.	Sodium chloride (NaCl).
	cc.	*g.*	*g.*	*g.*
No. 1	1,000	300	10	5
No. 2	1,000	300		
No. 3	1,000	100	20	7
No. 4	1,000	100		7
No. 5	1,000	100	5	5
No. 6	1,000	100	20	7
No. 7	1,000	100	5	7
No. 8	1,000	100		5
No. 9	1,000	300		7
No. 10	1,000	300	20	5

Table 6 summarizes the results of this test, which show that 0.5 per cent of peptone added to pupæ extract gives results as satisfactory as the ordinary meat-extract medium does.

TABLE 6.—*Growth of bacteria on each medium as given in Table 5.*

Species of bacteria.	Medium No.— 1	2	3	4	5
Bacillus coli communis	++	++	+++	+++	+++
Bacillus typhosus	+++	+	+++	+++	+++
Bacillus paratyphosus A	++	++	+++	+++	+++
Bacillus paratyphosus B	++	++	+++	+++	+++
Bacillus dysenteriæ Shiga	+	+	+++	++	+++
Bacillus dysenteriæ Flexner	++	+(?)	+++	++	+++
Bacillus dysenteriæ Y	++(?)	+	+++	+	+++

Species of bacteria.	Medium No.— 6	7	8	9	10	Contrast.
Bacillus coli communis	+++	+++	+++	+++	+++	+++
Bacillus typhosus	+++	++	+++	+++	+++	+++
Bacillus paratyphosus A	+++	+++	+++	+++	++	+++
Bacillus paratyphosus B	+++	+++	+++	+++	++	+++
Bacillus dysenteriæ Shiga	++	+	++	++	+	+++
Bacillus dysenteriæ Flexner	++	+	+	+	++	+++
Bacillus dysenteriæ Y	++	+++	++	+	++	+++

THE KINDS OF BACTERIA USED FOR THE TEST AND THE PROCEDURE OF TESTING

The following kinds of bacteria have been used for the test: *Bacillus typhosus, B. paratyphosus* A and B, *B. coli communis, B. dysenteriæ* Shiga, Y, and Flexner, and *Staphylococcus aureus, S. citreus,* and *S. albus.*

PROCEDURE

The purity of the cultures used having been first of all assured, a standard-loopful of growth on ordinary agar slant was suspended in 10 cc of sterilized salt solution. One loopful of this suspension was planted on an agar slant of pupæ extract and one on a meat-extract agar slant. Incubation at 37° C. for twenty-four and forty-eight hours followed and the abundance of growth was compared. The results of this test are tabulated and show that there was no appreciable difference in the luxuriance of growth on either medium.

TEST FOR BIOLOGIC HARMLESSNESS AND EVENTUAL TOXICITY OF THE MEDIUM MADE OF PUPÆ EXTRACT

Pupæ-extract broth was used for this test. By injecting the broth both subcutaneously and intraperitoneally into rabbits, mice, and guinea pigs it was ascertained that it is biologically inert inasmuch as no untoward effect followed the injections.

INQUIRY INTO THE EFFECT OF PUPÆ EXTRACT ON THE VIRULENCE OF BACTERIA GROWN ON IT

No difference in virulence of *B. typhosus* or *B. dysenteriæ* was found between the cultures grown on pupæ-extract media and those grown on meat-extract media.

TEST OF ANTIGENIC PROPERTIES OF BACTERIA GROWN ON PUPÆ-EXTRACT MEDIA

This test was performed in two directions. To test the antigenic property in vivo and in vitro one rabbit was immunized with *B. typhosus* grown on pupæ-extract agar and another one with the same bacterium grown on meat-extract agar. Suspensions were made of the two cultures each grown on the different media and cross agglutination was performed. Although the two sera thus obtained showed slight differences in their strength due to individual variation of the animals used, the results of tests in which the two suspensions were used with the same serum were the same, showing that the antigenic property of the same culture remained the same, whether grown on pupæ- or meat-extract culture media.

For the sake of brevity and for the reason that these tests showed no differences in their usefulness, the detailed records are not given, only the summary results.

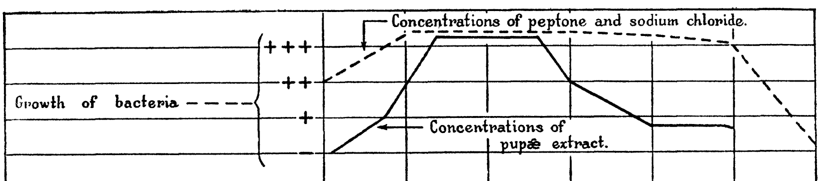
Likewise the data concerning our tests of the usefulness of pupæ extract for preparation of special media are omitted for the same reason. The tests consisted in preparing and testing the following culture media: Endo's medium, Drigalski-Conradi, Russell's double sugar medium, and Gassner's, Barsiekow's, Löffler's, and Petroff's media. These tests indicated that the pupæ extract is a suitable substitute for meat extract even in these special media.

The usefulness of this substitute that had been established by the author years ago (1930) having been reascertained by this recent investigation, the next step was to prepare the pupæ extract in such a form that it could be stored indefinitely and used conveniently whenever needed. We have therefore prepared an inspissated extract by evaporating it with the help of heat and vacuum to the consistence of a thick paste. In this form the substitute presents a soft brownish paste of lighter color than beef extract, it is readily dissolved and forms a slightly turbid, easily filtrable, liquid of the color of ordinary bouillon. Its smell recalls that of molasses rather than that of beef extract. To assure ourselves of the keeping quality we placed some of the extract paste into a wide-mouth sterilized container, closed it with a sterilized stopper, sealed it with par-

affin, and stored it in an ice chest. After having been stored for a full year, the pupæ extract has not changed its physical qualities, and biologic test showed it to be equal to beef extract.

The test at the end of a year's storage was arranged in such a manner that ordinary agar was prepared out of the extract, deep plates were poured and upon solidification the entire surface was divided into eight segments by drawing lines on the outside bottom of each plate and properly marking each segment thereon.

TABLE 7.—*Correlations of materials and bacterial growth.*



Peptone ——— per cent	----	0.5	0.75	1.0	1.5	2.0
Sodium chloride (NaCl)——do——	0.25	0.5	0.75	1.0	1.5	2.0
Pupæ ————do——	5.00	1.0	2.00	50.0	70.0	100.0

The plates were then planted with 24-hour cultures of various stock cultures in such a way that a small standard loopful of each culture was set in the middle of each segment without spreading it at all.

TABLE 8.—*Growth of media made of extract of pupæ stored for one year in an ice chest.*

Species of bacteria.	Pupæ.		Ordinary.	
	24 hrs.	48 hrs.	24 hrs.	48 hrs.
	cm.	*cm.*	*cm.*	*cm.*
Bacillus coli	0.57×1.06	0.68×1.14	0.43×0.6	0.67×0.75
Bacillus typhosus	0.42×0.9	0.46×1.0	0.53×0.65	0.72×1.20
Bacillus paratyphosus A	0.38×1.17	0.46×1.20	0.42×0.55	0.55×0.6
Bacillus paratyphosus B	0.55×0.6	0.6 ×0.6	0.38×0.52	0.52×0.72
Bacillus dysenteriæ Shiga	0.55×0.78	0.58×0.78	0.4 ×0.4	0.48×0.48
Bacillus dysenteriæ Flexner	0.4 ×1.42	0.45×1.46	0.4 ×0.47	0.42×0.59
Bacillus dysenteriæ Y	0.45×0.78	0.5 ×0.83	0.4 ×0.52	0.5 ×0.59
Vibrio cholera	0.45×0.9	0.96×0.45	0.34×0.4	0.4 ×0.5
Bacillus pyocyaneus	0.9 ×0.84	1.07×1.0	0.58×0.7	0.81×0.9
Bacillus prodigiosus	0.55×0.78	0.58×0.82	0.5 ×0.7	0.65×0.75
Diplococcus pneumoniæ [a]	0.47×0.65	0.49×0.65	0.32×0.37	0.5 ×0.42
Streptococcus [a]	0.5 ×0.5	0.52×0.67	0.39×0.47	0.46×0.59
Corynebacterium diphtheriæ	0.4 ×0.79	0.44×0.94	0.4 ×0.5	0.45×0.55

[a] 1 per cent glucose added.

Thus a round growth developed in each segment, the dimensions of which varied with the various kinds of bacteria used; they could, however, be conveniently measured. The measurements are given in Table 8, the two figures indicating the longest and the shortest diameter of the same round growth on the plates. The same manner of inoculation having been applied to plates of beef-extract agar, a comparison between the two media became possible. The result of this test is self evident and needs no further elucidation.

In order to illustrate the economic advantage of the pupæ-extract media, we affix the prices of materials as they prevail in Japan. The price relation is about 25: 130.

TABLE 9.—*Prices of materials.*

Material.	One l of ordinary agar.		One l of pupæ agar.	
	g.	*sen.*	*g.*	*sen.*
Meat	500	94.00		
Pupæ			100	0.45
Sodium chloride (NaCl)	5	0.21	5	0.21
Peptone	10	23.00	5	11.50
Agar	25	12.00	25	12.00
Total		129.21		24.16

SUMMARY

Experiments and experiences extending over five years have convinced us that the extract made from silkworm pupæ, a waste product of the silk industry, is in every respect of equal value, at times superior, to the beef extract in preparation of bacteriologic culture media. The reduction of expense resulting from the use of this substitute for laboratories that are engaged in the preparation of typhoid or cholera vaccines on a large scale amounts to about 75 per cent of the cost of culture media.

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THE PHILIPPINE FERNS COLLECTED BY J. B. STEERE

By E. B. COPELAND

Of the Department of Botany, University of California, Berkeley

This collection was a part of the subject of a paper by M. W. Harrington.[1] By the kindness of the late Prof. J. B. Pollock, I received a set of fragments of these ferns many years ago, and published some notes on them.[2] There are several reasons for a review now of the entire collection. Philippine botany has reached the stage where local distribution has an interest which could not be given to it thirty years ago; the labels show the locality in many cases in which it was not published; the labels differ from the published list in some cases, and are more likely to be correct; a few species are missing in the published list; some identifications require correction; and a revision of the synonymy may be helpful. The species follow in Harrington's sequence and with his names. The revised or corrected names are in italics.

CYATHEA SPINULOSA Wall.

Balabac, on low hills. The fragment is reasonably like some material from Assam, and also some specimens from Capiz, collected by Edaño. This is the only published record of the species from the Philippines.

ALSOPHILA LATEBROSA Hooker.

Mount Banahao, which is called "Mt. Mahayhay" on these labels. This species is *Cyathea latebrosa* (Wall.) Copel.

HYMENOPHYLLUM THUIDIUM Harr.

Mountains of Panay, growing on trunks of trees. Not collected again there, but we have very similar specimens from Mindanao and New Guinea. This is perfectly illustrated by Borbe's drawings in my monograph of *Hymenophyllum*.[3]

HYMENOPHYLLUM POLYANTHOS Swartz.

Mountains of Panay. This is typical *H. blumeanum,* in the reduction of which to *H. polyanthos* I concur.

[1] Journ. Linn. Soc. 16 (1877) 25.
[2] Philip. Journ. Sci. § C 2 (1907) 405.
[3] Philip. Journ. Sci., in a following issue.

HYMENOPHYLLUM JAVANICUM Spreng.

Mount Banahao. This is exactly *H. subdemissum* Christ, which also I reduce to *H. polyanthos.*

HYMENOPHYLLUM DILATATUM Swartz.

Mount Banahao, "new to this locality." However, this is the same as *Cuming 112,* which bore the same name and might have come from the same place. It is *H. badium* H. and G.

HYMENOPHYLLUM TUNBRIDGENSE Smith.

Mount Banahao. Very small and sterile; probably juvenile *Meringium meyenianum.* Real *H. tunbridgense* is unknown in the Philippines.

HYMENOPHYLLUM FRATERNUM Harr.

Mountains of Panay. Not *H. fraternum* Presl, and therefore renamed *H. Steerei* C. Chr. I consider it to be *H.* (*Mecodium*) *fimbriatum* J. Sm.

HYMENOPHYLLUM NEESII Hooker.

Luzon. *Hymenophyllum denticulatum* Sw.; common on Mount Banahao.

TRICHOMANES PARVULUM Poir.

Mount Banahao. *Gonocormus minutus* (Blume) V. D. B.

TRICHOMANES DIGITATUM Swartz.

Mount Banahao, "very high among the conifers, on trunks of trees like moss." In this, Professor Pollock distinguished No. 1, which is a form of *T. digitatum* with broad segments; and No. 2, which is a form of *Gonocormus minutus.*

TRICHOMANES PALLIDUM Blume.

Mount Banahao.

TRICHOMANES AURICULATUM Blume.

The published source is Luzon. There are two specimens. Of one, the label reads Isabela de Basilan, and the identification is correct. The other is from the mountains of Panay, and the collection was probably mixed; my fragment is *Cephalomanes oblongifolium* Presl.

TRICHOMANES SMITHII Hooker.

Mount Banahao. *Abrodictyum Cumingii* Presl.

TRICHOMANES APIIFOLIUM Presl.

Typical, from Mount Banahao; much reduced, but fertile, from mountains of Panay.

TRICHOMANES RIGIDUM Swartz.

Mountains of Panay. *Trichomanes obscurum* Blume.

DAVALLIA PEDATA Smith.

Mount Banahao. *Humata repens* (L. f.) Diels.

DAVALLIA AFFINIS Hooker.

"Locality new;" Mount Banahao. This is *Araiostegia hymenophylloides* (Blume) Copel., listed separately by Harrington, but not so sent to me. My three Cuming specimens of "*D. affinis*" are from Luzon, the only specified type locality.

DAVALLIA VESTIGA Blume.

Mount Banahao. *Humata vestiga* (Blume) Moore.

DAVALLIA PULCHELLA Hooker.

Luzon. Not seen.

DAVALLIA REPENS Desv.

"P. I." Probably *Lindsaya Merrillii* Copel.

DAVALLIA CONTIGUA Swartz.

Luzon. Not seen. (*Prosaptia.*)

DAVALLIA ELEGANS Swartz.

Mount Banahao. *Davallia embolostegia* Copel.

DAVALLIA (MICROLEPIA) PHILIPPINENSIS Harr.

Mount Banahao. This is *Tapeinidium philippinense* (Harr.) C. Chr. [4] Later collections on Banahao are *Elmer 7973* and *9024*. I do not know how to distinguish *T. moluccanum* C. Chr. or what *Dicksonia linearis* Cav. is.

LINDSAYA CONCINNA J. Sm.

"P. I." The label is *L. cultrata*, but the specimen is *L. concinna*, as published.

LINDSAYA LOBATA Poiret.

"Luzon and Balabac and Philippines." Not seen.

LINDSAYA DAVALLIOIDES Blume.

Mountains of Panay "on the ground in small clusters." Veins almost wholly free.

ADIANTUM LUNULATUM Burm.

Balabac. *Adiantum philippense* L.

CHEILANTHES TENUIFOLIA Swartz.

Balabac.

PTERIS INCISA Thunb.

Luzon. Not seen. (*Histiopteris.*)

[4] Index Suppl. (1934) 176.

LOMARIA AREOLARIS Harr.

"Growing in leaves of *Pandanus*, village of Mahayhay." *Stenochlaena areolaris* (Harr.) Copel.[5]

ASPLENIUM NIDUS Linn.

"Growing on ground among conifers." Probably *A. ficifolium* Goldm.

ASPLENIUM WIGHTIANUM Wall.[6]

ASPLENIUM TENERUM Forster.

Mount Banahao.

ASPLENIUM LUNULATUM Swartz.

Mountains of Panay. Also *A. tenerum.*

ASPLENIUM STEEREI Harr.

Mount Banahao. This is exactly *A. laxivenum* Copel. (1907), and *A. pseudofalcatum* var. *subintegra* Ros. (1915), of Formosa. Some, but not most, forms of the Hawaiian *A. pseudofalcatum* Hilleb. (1888) are indistinguishable from it. The Hawaiian species is best regarded as distinct.

ASPLENIUM AFFINE Swartz.

Mount Banahao.

ASPLENIUM CULTRATUM Mett.

Luzon. *Athyrium cultratum* (Presl) Milde; fairly common on Banahao, and unknown elsewhere.

ASPLENIUM RESECTUM Sm.

Asplenium unilaterale Lam. Not published as a Philippine collection, but the label reads "Mts. of Panay, on trees."

ASPLENIUM BANTAMENSE Baker.

Balabac. *Athyrium fraxinifolium* (Presl) Milde.

DIDYMOCHLAENA LUNULATA Desv.

Mountains of Panay. *Didymochlaena truncatula* (Swartz) J. Sm.

ASPIDIUM ACULEATUM Swartz.

Mount Banahao. Probably *Polystichum moluccense* (Blume) Moore.

ASPIDIUM ARISTATUM Swartz.

Mountains of Panay. *Polystichum aristatum* (Forster) Presl.

[5] See Philip. Journ. Sci. § C 2 (1907) 406, and Gardens' Bull. S. S. 5 (1932) 262.

[6] See Philip. Journ. Sci. § C 2 (1907) 406.

NEPHRODIUM LUERSSENI Harr.

"Bulukai Island," Philippines. *Dryopteris Luersseni* (Harr.) C. Chr.,[7] but this name must give way to *D. ligulata* (J. Sm.) O. K., the type collections being identical. I remain in doubt as to the identity of *D. Foxii.*

NEPHRODIUM BAKERI Harr.

Mountains of Panay. *Dryopteris Bakeri* (Harr.) Copel.[8]

NEPHRODIUM MOLLE Desv.

Published as from China, but the label reads "Mts. of Panay." My fragment is too small for certainty, but seems to be *Dryopteris diversiloba* (Presl) Christ.

NEPHRODIUM TRUNCATUM Presl.

Luzon. Not seen.

NEPHROLEPIS ACUTA Presl.

Mahayhay village.

NEPHROLEPIS RAMOSA Moore.

Isabela de Basilan. Not seen.

POLYPODIUM UROPHYLLUM Wall.

Balabac? *Dryopteris urophylla* (Wall.) C. Chr.

POLYPODIUM (GONIOPTERIS) AORISTISORUM Harr.

Mountains of Panay. *Dryopteris aoristisora* (Harr.) C. Chr.[9]

POLYPODIUM HIRTELLUM Blume.

Luzon. Not seen.

POLYPODIUM CUCULLATUM Nees.

Luzon. Not seen; presumably *Calymmodon gracilis* (Fée) Copel.

POLYPODIUM MINUTUM Blume.

Luzon. Not seen.

POLYPODIUM SCHENKII Harr.

Mountains of Panay. *Polypodium obliquatum* Blume.

POLYPODIUM CRATERISORUM Harr.

Mount Banahao. *Polypodium celebicum* Blume.

POLYPODIUM ADNASCENS Swartz.

"P. I." *Cyclophorus adnascens* (Swartz) Desv.

[7] Vide op. cit. 405. [8] Ibidem. [9] Vide ibidem.

POLYPODIUM (PHYMATODES) HAMMATISORUM Harr.

Mount Banahao. *Polypodium pyrolifolium* Goldm.

POLYPODIUM HETEROCARPUM Blume var. ZIPPELII H. and B.

"P. I." *Microsorium Zippelii* (Blume) Ching.

POLYPODIUM DIPTERIS Blume.

Mount Banahao. *Dipteris conjugata* Reinw.

POLYPODIUM PALMATUM Blume.

Mount Banahao. It is *P. albido-squamatum* Blume, with inconspicuous lime dots.

POLYPODIUM RUPESTRE Blume.

Mount Banahao. Not in the published list. *Polypodium triquetrum* Blume.

GYMNOGRAMME MACROPHYLLA Hooker.

Luzon. Not seen. (*Colysis.*)

ANTROPHYUM IMMERSUM Mett.

Philippines. Not seen.

ANTROPHYUM CALLAEFOLIUM Blume.

"P. I."

ANTROPHYUM SEMICOSTATUM Blume.

Mount Banahao.

VITTARIA ELONGATA Swartz.

Balabac.

VITTARIA FALCATA Kze.

Luzon. Not seen.

DRYMOGLOSSUM PILOSELLOIDES Presl.

Luzon.

HEMIONITIS ZOLLINGERI Kurz.

Mountains of Panay. *Hemigramma latifolia* (Meyen) Copel.[10]

ACROSTICHUM LATIFOLIUM Swartz.

Published as Luzon collection, but the fragment sent me is from Peru.

ACROSTICHUM AUREUM Linn.

Balabac. Not seen.

ACROSTICHUM PLATYRHYNCHOS Hooker.

Luzon. *Hymenolepis platyrhynchos* (J. Sm.) Kunze.

[10] Op. cit. 406.

ACROSTICHUM SPICATUM Linn.

Published as from Ternate; label is "P. I." *Hymenolepis* sp.

ACROSTICHUM AXILLARE Cav.

Not in the published list. "P. I." *Leptochilus axillaris* (Cav.) Kaulf., which is common about the foot of Banahao.

LYGODIUM DICHOTOMUM Swartz.

Balabac. *Lygodium circinnatum* (Burm.) Sw.

LYGODIUM SCANDENS Swartz.

"Mahayhay village." The specimen is *L. japonicum* (Thunb.) Swartz, but both species occur about Mahayhay.

ANGIOPTERIS EVECTA Hook.

"Mahayhay village." *Angiopteris angustifolia* Presl.

HELMINTHOSTACHYS ZEYLANICA Hooker.

Balabac.

The list includes two Lycopodineæ, not sent to me:

LYCOPODIUM PHLEGMARIA Linn.

SELAGINELLA sp.

Near *S. caulescens;* "probably a new species."

MISCELLANEOUS NOTES ON PHILIPPINE BOTANY

By E. D. MERRILL

Administrator of Botanical Collections, Harvard University, Cambridge

The data included in the present paper have been compiled over a period of several years as items have come to my attention regarding Philippine and supposed Philippine species that it seemed desirable to place on record. Thus, *Scleria macrophylla* Presl proves not to be a Philippine species, having been based on an erroneously labeled specimen originating in tropical America. *Macaranga sinensis* (Baill.) Muell.-Arg., erroneously supposed to have been based on a specimen from China, actually was based on material from Luzon, and the species does not occur in China; this binomial replaces *M. dipterocarpifolia* Merr. *Vitis cumingiana* Turcz., long considered to be a species of doubtful status, proves to be a synonym of *Bischofia javanica* Blume. The genera *Mezzettiopsis* Ridl., *Munronia* Wight, *Campnosperma* Thwaites, and *Acanthospermum* Schrank are new to the Philippine flora, while *Combretodendron* A. Chevalier (1909) replaces *Petersianthus* Merrill (1916). *Petalonema* Schlechter (1915), being invalidated by *Petalonema* Gilg (1897), was rechristened by Quisumbing in 1930 as *Schlechterianthus*. It is renamed *Quisumbingia* in honor of Dr. E. Quisumbing, of the Bureau of Science, Schwantes having applied the name *Schlechterianthus* to a genus of aizoaceous plants one year earlier than Quisumbing's use of it for the asclepiadaceous genus.

CYPERACEÆ

Genus SCLERIA Bergius

SCLERIA MACROPHYLLA Presl.

Scleria macrophylla PRESL, Rel. Haenk. 1 (1827) 200; MIQ., Fl. Ind. Bat. 3 (1857) 343; MERR., Enum. Philip. Fl. Pl. 1 (1923) 136; CORE, Brittonia 2 (1936) 37, pl. 3, fig. 25.

Scleria paludosa KUNTH, Enum. 2 (1837) 344.

Scleria macrocarpa SALZM. ex Schlecht., Bot. Zeit. 3 (1845) 492, in syn.; BOECK., Linnaea 38 (1874) 521, descr.

Scleria palmifolia HOFFMGG. ex. Schlecht., Bot. Zeit. 3 (1845) 492.

Ophryoscleria paludosa NEES in Mart., Fl. Bras. 2(1) (1842) 186.
Scleria asperrima STEUD., Syn. Pl. Cyp. (1855) 170.
Ophryoscleria asperrima LIEBM., Vidensk. Selsk. Skr. 5(2) (1851) 261.

Presl gives the locality, "Hab. in insula Luzon," and his species has been reduced to *Scleria bancana* Miq. This erroneous reduction was made by C. B. Clarke in Hook. f. Fl. Brit. Ind. 6 (1894) 693, perhaps largely on the assumption that Presl's indicated locality was correct; if correct, Presl's specific name would replace Miquel's for the Indo-Malaysian species. However, Presl's description does not remotely agree with the characters of *Scleria bancana* Miq. In excluding the species from the Philippine list in 1922, I stated that from the description it apparently belonged in the group with *Scleria macrocarpa* Nees, and that Presl's type was doubtless from Mexico or South America. Recently, in securing the loan of material for the use of Dr. E. L. Core, who was concerned at the New York Botanical Garden with a monographic study of the species of *Scleria* occurring in North and South America, it occurred to me that an examination of Presl's type would solve the problem of the identity of the species. Through the courtesy of the curator of the herbarium of the National Museum at Prague, we have been permitted to examine the authentic specimen collected by Haenke, on which Presl's description was based. It is labeled as above, but is, as suspected, an American plant and is the same as *Scleria macrocarpa* Salzm. = *S. palmifolia* Hoffmgg. and, further, is identical with the widely distributed tropical American *Scleria paludosa* Kunth. Presl's name being the older is here adopted in place of Kunth's. Presl's type doubtless came from Mexico, where Haenke collected previous to his departure with the Malaspina Expedition for the Philippines. This adjusted synonymy settles the status of another of the numerous originally mislabeled specimens in the collection of the Malaspina Expedition, and *Scleria macrophylla* Presl should disappear from the botanical literature of the Malaysian region. The species extends from Mexico and Central America to Trinidad, Bolivia, and Brazil.

POLYGONACEÆ

Genus POLYGONUM (Tournefort) Linnæus

POLYGONUM TOMENTOSUM Willd.

Polygonum tomentosum WILLD., Sp. Pl. 2 (1799) 447.
Polygonum attenuatum R. Br. var. *celebicum* MEISN., Miq. Ann. Mus. Bot. Lugd.-Bat. 2 (1865) 60.

Polygonum cumingianum GANDOGER, Bull. Soc. Bot. France **66** (1919) 224.

Polygonum celebicum DANSER, Bull. Jard. Bot. Buitenz. III **8** (1927) 165, *f. 6.*

If Danser is correct in referring the Philippine material to *Polygonum celebicum* (Meisn.) Danser, as a species distinct from *P. tomentosum* Willd., the former name is unnecessary, for as a binomial it is antedated eight years by *P. cumingianum* Gandoger, the latter species typified by *Cuming 617.* The Philippine *Polygonum tomentosum* Willd. conforms to Meisner's concept of Willdenow's species, if we may judge by the various specimens so named in Meisner's herbarium which is at the New York Botanical Garden.

MENISPERMACEÆ

Genus DIPLOCLISIA Miers

DIPLOCLISIA KUNSTLERI (King) Diels.

Diploclisia kunstleri (King) DIELS, Pflanzenreich **46** (iv. 94) (1910) 227.

Cocculus kunstleri KING, Journ. Asiat. Soc. Bengal **58** (2) (1889) 384.

Diploclisia macrocarpa GAGNEP. in Lecomte, Fl. Gen. Indo-Chine **1** (1908) 140, pro parte.

CULION, *Herre 1079,* April 29, 1931. Indochina, Malay Peninsula, Borneo; new to the Philippines.

ANNONACEÆ

Genus MEZZETTIOPSIS Ridley

MEZZETTIOPSIS CREAGHII Ridl.

Mezzettiopsis creaghii RIDL., Kew Bull. (1912) 389; Sarawak Mus. Journ. **1** (3) (1913) 97; MERR., Journ. Straits Br. Roy. As. Soc. Special No. 353 (1921).

Orophea palawanensis ELM., Leafl. Philip. Bot. **5** (1913) 1721; MERR., Enum. Philip. Fl. Pl. **2** (1923) 167, Univ. Calif. Publ. Bot. **15** (1928) 69, Lingnan Sci. Journ. **14** (1935) 5.

An examination of Ridley's type in the Kew Herbarium shows that it is identical with *Orophea palawanensis* Elm., and Ridley's name is the earlier. In studying my own collection of this species in 1914 and Elmer's Bornean collection in 1926, I realized that no *Orophea* was represented, but I failed then to refer it to any described genus, and so left it in *Orophea.* This monotypic genus is now known from British North Borneo, Palawan, and Hainan, and is represented by the following collections: BRITISH NORTH BORNEO, *Creagh, Elmer 20752, 20948.*

PALAWAN, *Elmer 12858, 12645, Merrill 9227.* HAINAN, *Tsang and Fung 18173, Lau 337.*

MELIACEÆ

Genus MUNRONIA Wight

MUNRONIA HUMILIS (Blanco) Harms.

Munronia humilis (Blanco) HARMS, Ber. Deutsch. Bot. Ges. 35 (1917) 80.

Plagianthus humilis BLANCO, Fl. Filip. (1837) 526.

Turraea humilis MERR., Govt. Lab. Publ. (Philip.) 27 (1905) 30, Enum. Philip. Fl. Pl. 2 (1923) 339.

LUZON.

MUNRONIA PALAWANENSIS (Merr.) Harms.

Munronia palawanensis (Merr.) HARMS, Ber. Deutsch. Bot. Ges. 35 (1917) 80.

Turraea palawanensis MERR., Philip. Journ. Sci. § C 9 (1904) 307.

PALAWAN.

In placing this in *Munronia,* where it apparently belongs rather than in *Turraea,* Harms inadvertently credited *Munronia palawanensis* to me, *Turraea palawanensis* being the binomial I actually published. To validate his new binomial the name-bringing synonym is here supplied. The species is very closely allied to *Munronia humilis* Harms. I overlooked Harms's paper on *Munronia* when preparing the manuscript for my enumeration of Philippine flowering plants.

EUPHORBIACEÆ

Genus MACARANGA Thouars

MACARANGA SINENSIS (Baill.) Muell.-Arg.

Macaranga sinensis (Baill.) MUELL.-ARG. in DC., Prodr. 15(2) (1866) 1001; GAGNEP., Bull. Soc. Bot. France 69 (1922) 705; PAX and HOFFM., Pflanzenreich 63 (IV. 147–VII) (1914) 351.

Adenoceras sinensis BAILL., Étud. Gén. Euphorb. (1858) 430; nomen nudum.

Macaranga dipterocarpifolia MERR., Philip. Journ. Sci. 1 (1906) Suppl. 205, Enum. Philip. Fl. Pl. 2 (1923) 441; PAX and HOFFM., Pflanzenreich 63 (IV. 147–VII) (1914) 338.

Mappa sinensis MUELL.-ARG. in DC., Prodr. 15(2) (1866) 1001, in syn.

Tanarius sinensis O. KTZ., Rev. Gen. Pl. (1921) 351.

This species occurs in the Philippines from the Batan Islands southward through Luzon to Cebu and Camiguin de Misamis, and also is found in Formosa and in Botel Tobago. Baillon apparently adopted the specific name *sinensis* under

some misconception, as his type in the Paris herbarium collected by Collery is clearly labeled, "Manille (Mont. Igorrotes)"—that is, probably in what is now Benguet Province, Luzon. Baillon, who published no description, does not indicate the place of origin, although one would assume from the specific name that he thought it came from China. Pax and Hoffmann's statement, "stammt wahrscheinlich aus Kwangtung," is a mere guess. Curiously both Pax and Hoffmann, and Gagnepain, whose examination of the type clearly indicated the identity of *Macaranga dipterocarpifolia* with the older *M. sinensis*, cite *Mappa sinensis* Baill.; Baillon never published this binomial, but rather *Adenoceras sinensis*. The species can with entire safety be removed from the Chinese list.

Genus BISCHOFIA Blume

BISCHOFIA JAVANICA Blume.

Bischofia javanica BLUME, Bijdr. (1826) 1168.
Vitis cumingiana TURCZ. in Bull. Soc. Nat. Mosc. 31 (1) (1858) 416, PLANCH. in DC., Monog. Phan. 5 (1887) 624; MERR., Enum. Philip. Fl. Pl. 3 (1923) 1 (sp. dub.).

Turczaninow's species was based on *Cuming 1173*, which is *Vitex turczaninowii* Merr., at least in some herbaria. I have not seen Turczaninow's specimen on which the description of *Vitis cumingiana* was based, but the sheet of this number in the Leningrad herbarium is a staminate specimen of *Bischofia javanica* Blume, with a fragment of an inflorescence of *Vitex turczaninowii* Merr. added. It may be noted that Turczaninow's description, "stylo sub nullo, stigmate peltato disciformi antheras tegente," does not apply to *Vitis*, and only approximately to *Bischofia;* it is suspected that Turczaninow misinterpreted the pistillode in the immature staminate flowers that he examined. Planchon erroneously cites the specimen as *Cuming 1113*.

ANACARDIACEÆ

Genus CAMPNOSPERMA Thwaites

CAMPNOSPERMA PHILIPPINENSIS sp. nov.

Arbor circiter 7 m alta, ramulis incrassatis, ultimis saltem 1 cm diametro, ferrugineo-pubescentibus; foliis confertis, sessilibus vel subsessilibus, coriaceis, oblanceolatis vel anguste oblongo-oblanceolatis, circiter 35 cm longis, 8 ad 11 cm latis, subolivaceis, apice rotundatis, deorsum angustatis, basi cuneatis, haud auriculatis, supra glabris vel junioribus secus costam pubescentibus, subtus plus minusve pubescentibus, nervis prima-

riis utrinque circiter 40, valde perspicuis; paniculis foliis subaequantibus, ferrugineo-pubescentibus, multifloris, breviter pedunculatis, ramis primariis usque ad 15 cm longis, patulis vel adscendentibus; floribus 5-meris, distincte (circiter 1.5 mm) pedicellatis, rubro-brunneis, sepalis orbiculari-ovatis, rotundatis, circiter 1 mm longis, glabris vel margine parcissime ciliatis; petalis oblongis, obtusis, glabris, 2.5 mm longis; staminibus 10, filamentis glabris, 1 mm longis, antheris circiter 0.5 mm longis; ovario ovoideo, subobliquo, leviter ciliato vel subglabro, stylis vix m 11 longis.

MINDANAO, Surigao Province, near Placer, *C. A. Wenzel 3199*, March 28, 1928, in forests, altitude about 150 meters.

A species belonging in the group with *Campnosperma griffithii* March. and *C. auriculata* Hook. f., of the Malay Peninsula and Borneo, differing from both particularly in its very much more numerous lateral nerves, the leaves distinctly pubescent beneath, and in its 5-merous flowers. This extension of generic range was to be expected in view of the fact that in Malaysia representatives of the genus were previously known to occur in the Malay Peninsula, Penang, Sumatra, Borneo, New Guinea, and the Caroline Islands.

LECYTHIDACEÆ

Genus COMBRETODENDRON A. Chevalier

COMBRETODENDRON QUADRIALATUM (Merr.) comb. nov.

Terminalia quadrialata MERR., Philip. Journ. Sci. § C 4 (1909) 301.

Petersianthus quadrialatus MERR., Philip. Journ. Sci. § C 11 (1916) 200, Enum. Philip. Fl. Pl. 3 (1923) 141.

Exell, Journ. Bot. 68 (1930) 181, calls attention to the fact that *Combretodendron* A. Chevalier (1909) is congeneric with *Petersia* Welwitch (1867) non Klotzsch (1861), for which I proposed the new generic name *Petersianthus* in 1916. I here transfer the Philippine species to *Combretodendron* as I am confident that it is congeneric with the African species.

PRIMULACEÆ

Genus LYSIMACHIA Tournefort

LYSIMACHIA FRAGRANS Hayata.

Lysimachia fragrans HAYATA, Journ. Col. Sci. Tokyo 30(1) (1911) 175; HAND.-MAZ. in Notes Bot. Gard. Edinb. 16 (1931) 167.

Lysimachia ramosa sensu MERR., Enum. Philip. Fl. Plants 3 (1923) 275, non Wall.

Not having any authentic material representing *Lysimachia ramosa* Wall., I followed Pax and Kunth in referring the

Philippine form to Wallich's species, although the Philippine plant is normally unbranched. Handel-Mazettii is undoubtedly correct in referring the Philippine specimens to Hayata's species, which was described from Formosan material; I have the same species from Kwangtung and Kwangsi Provinces in China.

ASCLEPIADACEÆ

Genus QUISUMBINGIA nom. nov.

Petalonema SCHLTR., 1915, non Gilg, 1897.
Schlechterianthus QUIS., 1930, non Schwantes, 1929.

QUISUMBINGIA MERRILLII (Schltr.) comb. nov.

Petalonema merrillii SCHLTR., Repert. Sp. Nov. 13 (1915) 554; MERR., Enum. Philip. Fl. Pl. 3 (1923) 356.
Schlechterianthus merrillii QUIS., Philip. Journ. Sci. 41 (1930) 342.

A new generic name is manifestly needed for this endemic Philippine asclepiadaceous genus. The new name, here proposed, is dedicated to Dr. E. Quisumbing, chief botanist, Bureau of Science, who first noticed that Schlechter's generic name was a homonym and hence invalid. Gilg used the generic name *Petalonema* in 1897 for an African genus of the Melastomataceæ, which Schlechter overlooked when he named and described the Philippine genus. In 1929 Schwantes proposed the generic name *Schlechterianthus* for an African group of the Aizoaceæ, thus invalidating Quisumbing's substitute name for *Petalonema* Schltr., non Gilg, published in 1930.

RUBIACEÆ

Genus BORRERIA G. F. W. Meyer

BORRERIA ARTICULARIS (Linn. f.) F. N. Williams.

Borreria articularis (Linn. f.) F. N. WILLIAMS, Bull. Herb. Bois. II 5 (1905) 956.
Spermacoce articularis LINN. f., Suppl. (1781) 119, excl. syn. Rumph.
Spermacoce flexuosa LOUR., Fl. Cochinch. (1790) 79.
Spermacoce hispida LINN., Sp. Pl. (1753) 102.
Borreria hispida K. SCHUM. in Engl. and Prantl, Nat. Pflanzenfam. 4(4) (1891) 144, non Spruce (1888).
Borreria discolor BARTL. in DC., Prodr. 4 (1830) 545.
Spermacoce mutilata BLANCO, Fl. Filip. ed. 2 (1845) 43.
Spermacoce scabra WILLD., Sp. Pl. 1 (1797) 572.

Prof. W. G. Craib wrote to me in November, 1932, pointing out that *Borreria hispida* K. Schum. (1891) was invalidated by *Borreria hispida* Spruce, a very different species, actually described by K. Schumann in the Flora Braziliensis three years

earlier, and asking if I had any further information as to the identity of *Borreria discolor* Bartl. I suggested to him that the identity of *Spermacoce articularis* Linn. f. should be settled first, as the description apparently applied to the species under discussion, although the Rumphian illustration cited represented the very different *Hedyotis verticillata* Lam. Professor Craib finds that the specimen of *Spermacoce articularis* Linn. f. in the Linnæan herbarium represents the species commonly known as *Borreria hispida* K. Schum. (*Spermacoce hispida* Linn.), and I accordingly follow him in accepting the binomial *Borreria articularis* (Linn. f.) F. N. Williams for this very common and widely distributed weed.

BORRERIA LAEVIS (Lam.) Griseb.

Borreria laevis (Lam.) GRISEB., Fl. Brit. West Ind. 1 (1861) 349.
Spermacoce laevis LAM., Tabl. Encycl. 1 (1791) 273.

JOLO, *Bur. Sci. 44416 Ramos and Edaño,* September, 1924, distributed as *Hedyotis* sp.

A widely distributed species in tropical America, now occurring as a weed in Java, Sumatra, Singapore, New Guinea, New Britain, and Samoa, and doubtlessly in many other parts of the Indo-Malaysian and Polynesian regions. It is, however, of comparatively recent introduction, in most Old World localities, where it now occurs, apparently introduced and disseminated within the present century.

Genus HEDYOTIS Linnæus

HEDYOTIS MONOCEPHALA Miq.

Hedyotis monocephala MIQ., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 255.
Scleromitrion capitatum MIQ., Fl. Ind. Bat. 2 (1857) 186, non *Hedyotis capitata* Lam.
Oldenlandia monocephala BOERL. ex Koord., Exkursionsfl. Java 3 (1912) 240, non O. Ktze., 1891.
Hedyotis miqueliana VAL., Bot. Jahrb. 44 (1910) 545, descr. ampl.
Hedyotis connata MERR., Enum. Philip. Fl. Pl. 3 (1923) 496, non Hook. f.

Miquel's specific name is valid in *Hedyotis* for I have found no published description of *H. monocephala* R. Br., *nomen nudum,* Wall. List (1829) 213, "846 pro *macrocephala* lege *monocephala,*" previous to Hooker's consideration of it, Fl. Brit. Ind. 3 (1880) 63. *Hedyotis macrocephala* R. Br. in Wall. List (1829) No. 846, is a nomen nudum, *H. monocephala* intended; see below. *Hedyotis connata* Hook. f. Fl. Brit. Ind. 3 (1880) 62, (*Oldenlandia connata* K. Schum.) is a false name as he misread *H. connata* Wall. List (1829) No. 856, nomen nudum, and

in this error he was followed by King and Gamble, by myself in my erroneous interpretation of the species in 1923, and by Pitard (sub *Oldenlandia*). An additional specimen is *Bur. Sci. 44223 Ramos and Edaño*, from Tawitawi, Sulu Archipelago, July and August, 1924, distributed as *H. radicans*. It occurs also in Java and in Borneo.

HEDYOTIS BRUNONIS nom. nov.

Hedyotis macrocephala R. Br. in Wall. List (1829) No. 846, nomen nudum (error for *H. monocephala* R. Br.).

Hedyotis monocephala R. Br. in Wall. List (1829) 213, "No. 846 pro *macrocephala* lege *monocephala*"; Hook. f., Fl. Brit. Ind. 3 (1880) 63, non Miq. 1869.

Oldenlandia monocephala O. Ktz., Rev. Gen. Pl. (1891) 292.

Silhet, Assam, and Upper Assam.

Were *H. macrocephala* R. Br. an appropriate name the proper course would be to validate it. However it was published as a nomen nudum, in error, and was corrected to *monocephala* a little later by Brown himself, the latter also a nomen nudum. The specific name "*macrocephala*" is in no way a descriptive one for the species in question, and accordingly it seems appropriate to propose a new one for this distinct species. *Hedyotis monocephala* R. Br. is invalidated by *H. monocephala* Miq.

COMPOSITÆ

Genus ACANTHOSPERMUM Schrank

ACANTHOSPERMUM HISPIDUM DC.

Acanthospermum hispidum DC., Prodr. 5 (1838) 522; Blake, Contr. U. S. Nat. Herb. 20 (1921) 386, *t. 23. f. C.*

Cebu, *Aron Valentin*, October 6, 1929, herb. Stockholm, fragment in the Gray Herbarium. Widely distributed in North and South America, introduced in the Philippines as it is in Hawaii, Australia, and tropical Africa. The allied American *A. australe* (Loefﬂ.) O. Ktz. (*A. brasilum* Schrank) occurs as an introduced plant in Hawaii and in Singapore.

The genus is new to the Philippines.

A FRESH-WATER JELLYFISH IN THE PHILIPPINES

By HILARIO A. ROXAS

Of the Fish and Game Administration, Bureau of Science, Manila

ONE PLATE

July 12, 1935, Mr. Agustin F. Umali saw a number of jellyfishes in one of the fresh-water nursery tanks that compose the Bureau of Science propagation pond system. After the discovery the contents of the tank were carefully examined daily. Scrapings from the bottom and sides, as well as roots and leaves of plants in the tank, were examined under the microscope. No hydroid form was seen. Although not found, individuals in the hydroid stage must have been present in the tank as small medusæ were seen July 24. These must have been liberated a few days before.

When first seen the medusæ measured about 1.6 mm in diameter and had four sets of tentacles: 4 perradials, which are largest and most prominent; 4 interradials, 8 adradials, and 16 tentacles of the fourth set between the adradials and the perradials and between the adradials and the interradials, a total of 32 tentacles. August 22 they had grown to about 3 mm in diameter with seven sets of tentacles, or a total of about 256. The gonad rudiments were clearly visible as small projections at each junction of the stomach and the radial canals.

The fully grown jellyfish measures 13 to 15 mm in diameter, and the fully developed gonad is about 5 mm long and 2 mm wide. All adult forms examined for sex were males; no female individual was ever found. The jellyfish is very transparent and colorless, except the stomach and the gonads, which are whitish and opaque. The medusæ frequent the bottom of the tank during cool rainy days. They come to the surface during the early mornings when the weather is clear, only to descend to the bottom again when the water becomes warm and the sun bright. August 30 not a single specimen of the jellyfish could be found. They had disappeared as mysteriously as they appeared.

The finding of the jellyfish in this particular tank was strange as it was not found in the other tanks nearby where conditions

appear exactly identical. Nursery tank 2 contains badly trimmed *Hydrilla verticillata, Najas palustris,* and *Chara* sp. as these are continually eaten by gourami, which are kept in the tank. Besides gourami the tank contains a number of *Mollenesia* and *Gambusia.* In 1933 this tank was a veritable *Daphnia* tank. All the ponds in the system were built about the middle of 1927. They have a concrete bottom, filled with ordinary loam to a depth of about 1 foot, in which the water plants take root to grow and multiply. The original plants, consisting of *Nymphæa stellata, Hydrilla* sp., *Naja* sp., *Chara* sp., *Vallisneria gigantea,* dwarf vallisneria (*Vallisneria* sp.), and *Ottelia alismoides,* planted in the different tanks, came from Taguig, Rizal Province. Some specimens of water lily were said to have been brought from Baguio, Mountain Province, while a few came from Dinalupihan, Bataan. The water used for filling the ponds is ordinary tap water from the mains of the City of Manila. Loss through evaporation is compensated by rain water during the rainy season. The temperature of the water ranges from 27° to 32° C.

The morphological structures of this fresh-water jellyfish conform to those of the genus *Craspedacusta,* which is diagnosed as follows:

Umbrella flattened or hemispherical; stomach flat, with 4 corners; radial canals 4, opening to ring canal which is well developed, seemingly wide and communicating with lumen of tentacles; centripetal canal absent; manubrium more or less rectangular in cross section, with 4 perradial lobes; tentacles solid, over 200, of different sizes, with roots embedded in the exumbrellar gelatinous substance; marginal ring present, connected with the roots of the tentacles; otocyst over 100, with elongations towards the margin of the velum; ocelli, absent. Gonads 4, hanging from the radial canal.

The first discovery of jellyfish inhabiting fresh water was made June 17, 1880, when E. Ray Lankester reported to the Royal Society of England the existence of a remarkable medusa in a tank in a water-lily house in Regent's Park, London. As it was found among plants of tropical origin, and as it flourished under high temperature (90° F.), Lankester deduced that this medusa was a tropical species, probably introduced from the West Indies. He placed the animal among the Trachomedusæ, family Petasidæ, and called it *Craspedacusta sowerbyi,* after Mr. Sowerby, secretary of the Botanical Society of London, who first observed the medusa in the tank. Within a week Mr.

Sowerby sent specimens of the same animal to Allman who, not knowing the previous report of Lankester, called it *Limnocodium victoria.*

The medusa reappeared June 16, 1881, and was the subject of further studies. As in the previous year, although "newly hatched" and young jellyfishes were observed, the mature ones were all males and the various observers were left in ignorance of the female *Craspedacusta* and its hydroid form. Four years later, however, A. G. Bourne reported the existence of a sessile animal with nematocysts attached to the roots of *Pontederia,* which he regarded as the possible hydroid form of *Craspedacusta.* May 11, 1888, or about nine years after the discovery of the adult jellyfish, G. Herbert Fowler observed the actual formation of the medusoids from the hydroid form previously reported by Bourne.

In 1901 Vaney and Conte reported the discovery by Chifflat of numerous jellyfish in a water-lily pond in Parc de la Beta d'or at Lyon, France, while in 1905 E. Boecker reported the existence of an animal identical with *Craspedacusta* in a fresh-water pond full of water lilies (*Victoria regia*) in a warm-water pond in the Botanical Garden of Munich, Germany.

August 17, 1907, C. W. Hargitt, while at Woods Hole, Massachusetts, received from Washington, District of Columbia, a few medusæ which were identified as a species of *Craspedacusta.* September 30, 1907, Hargitt received a letter saying that the medusæ had suddenly disappeared. The specimens had been discovered in the aquarium of W. B. Shaw, a florist, who for many years had cultivated various aquatic plants. The appearance of the medusæ seemed mysterious at the time, as all plants in the tanks were reared from seeds and no grown plants had been at any time imported or introduced from an outside source; no specimen of *Victoria regia* or *Pontederia,* the plants associated with this jellyfish in Europe, had ever been in the Washington tank.

September 26, 1916, numerous medusæ were seen in Benson Creek, near Frankfort, about 28 miles from Lexington, Kentucky, and were reported by H. Garman. After a brief comparison with the various fresh-water medusæ then known, Garman came to the conclusion that it was "best for the present to regard the Kentucky medusae as a form of *C. sowerbyi.*"

In 1918 Payne reported the presence of numerous specimens of a fresh-water medusa and its hydroid form in Boss Lake, near Elkhart, Indiana. The medusæ examined during 1919,

1920, and 1921 were all females, in sharp contrast to other finds where only males were obtained. He obtained sexually mature eggs and was able to follow the development of the jellyfish from the hydroid stage to the formation of the free-swimming medusa. The studies of Payne led him to believe that the animal previously described as *Mycrohydra ryderi* and reported by Potts (1897, 1906) was identical with the form he studied. He reduced the genus *Mycrohydra* to *Craspedacusta* and called the animal *Craspedacusta ryderi* (Potts).

Oka, in 1907, reported a fresh-water jellyfish from Jantsekiang in the neighborhood of Itschang which he called *Limnocodium kawaii.* He differentiated this from *Craspedacusta sowerbyi* in being much larger, in having a more convex umbrella, and in having seven sets of tentacles, instead of three sets as found in *C. sowerbyi.*

A comparison of the Philippine form of fresh-water jellyfish with those reported in England, Europe, North America, and China leads me to believe that it belongs to the species *Craspedacusta kawaii* (Oka).

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ILLUSTRATION

PLATE 1. *Craspedacusta kawaii* (Oka), a fresh-water jellyfish, drawn from Philippine specimens.

PLATE 1.

DIROFILARIA IMMITIS LEIDY AND ITS CULICINE INTERMEDIATE HOSTS IN MANILA, I

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ONE PLATE

INTRODUCTION

Dirofilariasis immitis, or dog filariasis, is essentially a disease of dogs caused by *Dirofilaria immitis* Leidy, a nematode parasite inhabiting the circulatory system. The name of the disease has been coined accordingly to distinguish it from human filariasis. The life cycle of *D. immitis* may be briefly summarized as follows: The microfilariæ or the filarial embryos, which are liberated by the mature worms in the blood of the dog, are microscopic and motile. The sexually mature filariæ are located generally in the heart. The embryos, when sucked up with the blood by the appropriate mosquito during the act of feeding, migrate from the stomach to the Malpighian tubules. Further development of the embryos in the Malpighian tubules of the mosquito takes place until they reach the infective stage. The infective filariæ are thrown off in the body cavity of the mosquito, from which they make their way to the labium. Sooner or later the infective mosquito bites another dog and the filariæ pass from the labium of the mosquito into the puncture in the skin of the canine host. They then wriggle about and find their way into the circulation from which they reach the heart, where they become sexually mature adults. Unless a mature male and a mature female happen to be together in the same heart, no further development occurs. The embryos liberated by the female in the blood circulate as microfilariæ. Thus the cycle is completed.

[1] I wish to acknowledge the generous assistance and interest of Dr. C. M. Africa, head of the Department of Parasitology, School of Hygiene and Public Health, University of the Philippines, under whose general guidance the work was carried out. To Dr. P. Villa, veterinarian in charge of the Manila City Pound, for extending to me his facilities in obtaining infected dogs; and to Dr. M. Tubangui, chief of the biological division, Bureau of Science, for his valuable counsel and numerous suggestions and for reading the manuscript of this paper, I record my thanks.

In 1878 Manson expounded the theory that the mosquito might be the vector of *Wucheraria bancrofti* Cobbold. He confirmed a portion of his hypothesis in 1884 when he observed the metamorphosis of the microfilaria within the body of the mosquito. As a result of this brilliant discovery, numerous investigators made further experiments, which finally established the fact that the mosquito is the intermediate host of the filaria.

To Grassi (1900), however, belongs the credit of having discovered the intermediate host of *D. immitis*. This author, while engaged in the study of malaria, had observed filariæ in the body of *Anopheles maculipennis* Meigen, a malarial mosquito. These filariæ were found to be developmental forms of *D. immitis*. To verify his belief Grassi, in 1900, made experimental infections with *D. immitis*. After a year he was able to recover sexually mature filariæ from dogs, which had been bitten by adults of *A. maculipennis* that contained the infective stage of the filaria in their labia. Following the researches of Grassi a number of experimenters in different parts of the world tried to trace the development of *D. immitis* in other species of mosquitoes. The following species are reported as intermediate hosts of the dog filaria in the respective countries indicated:

1. *Anopheles maculipennis* Meigen. Italy.
2. *Anopheles bifurcatus* Linnæus. Italy.
3. *Anopheles hyrcanus* Pallas var. *pseudopictus* Grassi. Italy.
4. *Anopheles superpictus* Grassi. Italy.
5. *Anopheles algeriensis* Theobald. North Africa.
6. *Anopheles hyrcanus* var. *sinensis* Wiedemann. China.
7. *Anopheles punctipennis* Say. United States.
8. *Aëdes ægypti* Linnæus. ("*Stegomyia fasciata.*") Australia.
9. *Aëdes vexans* Meigen. ("*Culex malaria.*") Italy.
10. *Aëdes caspius* Pallas. Italy.
11. *Aëdes koreicus* Edwards. China.
12. *Aëdes canadensis* Theobald. United States.
13. *Aëdes sollicitans* Walker. United States.
14. *Aëdes taeniorhynchus* Wiedemann. United States.
15. *Culex pipiens* Linnæus. Italy.
16. *Culex fatigans* Wiedemann. ("*skussi.*") Australia.
17. *Culex territans* Walker. United States.

Although it is well known that dogs in Manila are infected with *D. immitis*, no studies have been conducted to test the local species of mosquitoes with regards to their suitability as transmitters of this parasite. During August, 1935, in examinations of dogs in the Manila City Pound, I had an opportunity to isolate dogs with microfilariæ in the blood. With these animals as subjects a series of biting experiments were carried on with

the local culicine species. The results of these experiments with *Culex quinquefasciatus* Say (*C. fatigans* Wied.) and *Stegomyia fasciata* (*Aëdes ægypti* Linnæus) are herein presented.

MATERIALS AND METHODS

The different species of mosquitoes used in this experiment were collected in the vicinity of Manila. The larvæ were reared in white enameled pans with Fleischmann's yeast as food. The pupæ are removed by means of a pipette into glass jars, each covered with a screened lamp chimney. Upon the emergence of the adults the glass jar was replaced by a Petri dish containing moistened cotton. The adults were fed by placing boiled raisins over the screen netting. The raisins were changed daily, and the cotton pad was always kept moist.

The infection experiments were carried on in a rectangular cage made of cheese cloth, which measures 100 by 50 by 155 centimeters. The dog used was tame, and repeated examinations of the blood by a thin smear showed 8,077 and 7,280 microfilariæ per 2 cubic millimeters (taken at 5 p. m., August 20 and 22, 1935).[2] The dog's hair was clipped from an area of about 225 square centimeters on the back of the animal before the biting experiments. The wire-screened cage containing the infected dog was introduced into the large cage, and the starved female mosquitoes were liberated inside. The next morning the engorged females were caught by means of a suction rubber tube and placed in the screened lamp chimneys, where they were fed with raisins and cared for until they were ready for dissection.

The infected mosquitos that were ready for dissection were immobilized with chloroform or ether, and the usual technic of removing the Malpighian tubules by means of dissecting needles was employed. Mosquitoes that died in the earlier stages of infection were dissected and the Malpighian tubules and stomach were examined for the microfilaria. In those that were killed after seven or more days, searches were made for the microfilaria, not only in the Malpighian tubules but also in the head and labium, thorax, and abdomen. Infected specimens were either mounted in Gater's mounting fluid or stained with Giemsa. Specimens that were to be sectioned were placed in Bless's fluid.

[2] For their kindness in furnishing me these data, I am indebted to Drs. E. Y. Garcia and P. Refuerzo, both of the department of parasitology, School of Hygiene and Public Health, University of the Philippines.

DISCUSSION AND RESULTS

EXPERIMENTS WITH CULEX QUINQUEFASCIATUS SAY

Culex quinquefasciatus Say is a very widespread species that occurs in tropical and subtropical countries. In the Philippines it is the commonest species of *Culex* encountered. It breeds in or near houses in sewage-contaminated water, such as that in street ditches of towns and villages, and in clean water, such as rain water in tanks, reservoirs, etc. The adult is a night flier and bites at nightfall.

The mosquitoes in this series of experimental infections were all bred from *C. quinquefasciatus* larvæ and pupæ in the laboratory. They were collected from standing rain water in the basement of the Bureau of Science building.

As shown in Table 1, seven batches of mosquitoes were used in the feeding experiments. Of 149 mosquitoes which fed on the infected dogs from August 25 to September 5, 1935, 108, or 72.4 per cent, were positive for the filaria. The filarial larvæ were found to be in different stages of development in the body of the mosquito. An individual mosquito was counted as positive for filariæ only when all the filarial larvæ found in the body of the culicine host had already attained sexual maturity or when they appeared to be on their way to attain the infective stage. Hu (1931), who made some earlier observations on the host-parasite relationships of *D. immitis* and its culicine intermediate hosts, reported, "it appears that once the microfilaria [æ] have established themselves in the Malpighian tubules, they are generally able to continue their development till they come to full maturity." This conclusion of Hu was applied to the observations herein reported.

The migration of the microfilariæ from the stomach to the Malpighian tubules is accomplished in about twelve hours after feeding. The shortest time in which the larvæ become sausage-shaped is five days, as shown in the results of experiments 3, 6, and 7. The whole development is completed in ten to twelve days; the infective stage in the labium was noted between eleven and thirteen days. This finding is in accord with the findings of Feng (1930), in China, who found that in *Anopheles hyrcanus* var. *sinensis* and *Aëdes koreicus* the whole development of *D. immitis* is completed in ten to fifteen days, and between twelve and fifteen days they proceed forward to the labium.

It is interesting to note also that in the seven batches of mosquitoes tested there appears to be only a slight variation in the percentage infection of the different batches. In expe-

riment 1, 70 per cent became infected; in experiment 2, 66 per cent; in experiment 3, 64 per cent; in experiment 4, 72 per cent; in experiment 5, 69 per cent; in experiment 6, 65 per cent; and in experiment 7, 63 per cent. These results are probably to be expected inasmuch as in this investigation all the batches of mosquitoes were collected from the same breeding place, where the nature of the nourishment for the growth of the larvæ is more or less uniform. This also suggests the possibility that this more or less uniform percentage of infection may be a characteristic peculiar to *C. quinquefasciatus*.

In Plates 1 and 2 are shown the larvæ of *D. immitis* in a portion of a Malpighian tubule and the proboscis of *C. quinquefasciatus*. The Malpighian tubule was photographed eight days after being infected. The temperature varied at that time between 28° and 31° C., and the relative humidity between 85 and 95. The infective larvæ in the proboscis were photographed fourteen days after infection. Not enough of the infective larvæ were measured to give averages, but the two photographed measured, respectively, 32 μ by 864 μ and 29 μ by 896 μ.

EXPERIMENT WITH STEGOMYIA FASCIATA (AËDES ÆGYPTI LINNÆUS)

Stegomyia fasciata has a distribution similar to that of *Culex quinquefasciatus* Say. This mosquito is distinctly domestic in its habits. The larvæ may be found in all kinds of containers where water collects in and around houses, and they prefer fresh clean rain water collected in water barrels, cans, bottles, roof gutters, etc. This species does not seem to like to breed in cesspools or in sewage-contaminated water. The adults bite in the daytime.

The mosquitoes in this experiment were collected from several rain-water barrels. The starved female mosquitoes bred from the larvæ were liberated inside the cage containing the infected dog early in the morning, and the engorged ones were collected late in the afternoon.

The data from this experiment are summarized in Table 2. Dissections were made between the second and seventeenth days after feeding. It is seen that 71 mosquitoes, or 73.8 per cent, of 96 mosquitoes that took blood were positive. This result seems to indicate that, as far as the susceptibility to infection with *D. immitis* is concerned, *Stegomyia fasciata* is probably about in the same group as *Culex quinquefasciatus*. These findings may be regarded as only a coincidence, but the uniformity of the percentage of infection in the different batches in both species must be significant.

The infective stage was found in *S. fasciata* as early as eleven days after the blood meal. Although only a small number of *S. fasciata* was infected as compared with *C. quinquefasciatus,* the intensity of infection is apparent. A large number of specimens of *S. fasciata* having the infective stage showed a higher worm count than that obtained with *C. quinquefasciatus.* In one specimen of *S. fasciata,* fourteen filariæ were found in the labium, two in the head, two in the thorax, and four in the Malpighian tubules.

An attempt was made to compare in a systematic way the development of the parasite in both species, but due to the large number of mosquitoes that had to be dissected daily this was not carried out. However, it was noted in both species that the filariæ, whenever dissections were made in fresh mosquitoes, showed a slow movement by about the seventh or eighth day. About the tenth day there was a slight increase in the motion, and from the eleventh to the fifteenth day the filariæ were extremely active.

SUMMARY AND CONCLUSION

This paper deals with the study of the suitability of *Culex quinquefasciatus* Say and *Stegomyia fasciata* (*Aëdes ægypti* Linnæus), two local species of mosquitoes, as transmitters of *Dirofilaria immitis* Leidy in Manila. The experimental results may be summarized as follows:

1. Of *Culex quinquefasciatus* Say, 149 mosquitoes fed on a carrier were dissected; 108, or 72.4 per cent, of these were infective. In *Stegomyia fasciata* the percentage infection was found to be 73.8 per cent.

2. The development of *Dirofilaria immitis* to the infective stage in the labium was traced in *C. quinquefasciatus* and in *Stegomyia fasciata.*

3. The more or less uniform percentage of infection found in *C. quinquefasciatus* suggests the possibility that it is characteristic of this local species.

4. The suitability of *Stegomyia fasciata* to infection with *Dirofilaria immitis* Leidy is about on the same footing as that of *C. quinquefasciatus* Say. In the former species a large number of specimens showed a heavy worm count.

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TABLE 1.—*Data from dissections of Culex quinquefasciatus Say infected with Dirofilaria immitis Leidy.*

EXPERIMENT 1; 17 MOSQUITOES, FED AUGUST 25, 1935.

Mosquitoes dissected.			Results of dissections and remarks.
Days after feeding.	Died.	Killed.	
1	1	--------	Stomach with many living premature larvæ; a few in Malpighian tubules.
3	1	--------	Stomach with many dead premature larvæ.
7	--------	1	6 premature larvæ (sausage-shaped) in Malpighian tubules.
8	--------	1	7 premature larvæ (sausage-shaped) in Malpighian tubules.
9	--------	1	4 premature larvæ (sausage-shaped) in Malpighian tubules.
10	1	--------	Negative.
12	--------	4	*a*, 1 specimen positive in Malpighian tubules (calcified).
			b, 3 specimens negative.
13	--------	3	All positive; 2 mature larvæ in each labium.
14	--------	4	*a*, 1 mature larva in thorax; 2 mature larvæ in labium.
			b, 3 mature larvæ in labium.
			c, 2 mature larvæ in labium.
			d, 4 mature larvæ in labium.
EXPERIMENT 2; 18 MOSQUITOES, FED JULY 26, 1935.			
1	1	--------	Stomach with a few living premature larvæ; none in Malpighian tubules.
2	2	--------	Stomach with dead premature larvæ; none in Malpighian tubules.
3	2	--------	Both negative.
4	2	--------	Both positive, about 7 premature larvæ in each Malpighian tubule.
5	1	--------	Negative.
6	--------	1	8 premature larvæ (sausage-shaped) in Malpighian tubules.
8	--------	1	7 premature larvæ (advanced sausage-shaped) in Malpighian tubules.
9	1	--------	4 premature larvæ (advanced sausage-shaped) in Malpighian tubules.
12	--------	1	8 premature larvæ (elongated) in Malpighian tubules.
12	--------	3	*a*, Positive in Malpighian tubules (calcified).
			b, 3 mature larvæ in labium.
			c, Positive in Malpighian tubules (calcified).
14	--------	3	*a*, 4 mature larvæ in labium.
			b, 1 mature larva in thorax; 2 mature larvæ in labium.
			c, 3 mature larvæ in the labium.

TABLE 1.—*Data from dissections of Culex quinquefasciatus Say infected with Dirofilaria immitis Leidy*—Continued.

EXPERIMENT 3; 14 MOSQUITOES, FED AUGUST 27, 1935.

Mosquitoes dissected. Days after feeding.	Died.	Killed.	Results of dissections and remarks.
1	2	--------	Both negative in Malpighian tubules.
2	2	--------	Do.
3	2	--------	*a*, 6 premature larvæ in Malpighian tubules.
			b, 8 premature larvæ in Malpighian tubules.
5	--------	1	1 premature larva in Malpighian tubules.
7	--------	1	9 premature larvæ (sausage-shaped) in Malpighian tubules.
9	--------	1	5 premature larvæ (sausage-shaped) in Malpighian tubules.
11	--------	1	4 premature larvæ (elongated) in Malpighian tubules.
12	--------	2	*a*, 2 mature larvæ in labium.
			b, 1 specimen negative.
14	--------	2	*a*, 2 mature larvæ in head.
			b, 4 mature larvæ in labium.

EXPERIMENT 4; 29 MOSQUITOES, FED AUGUST 28, 1935.

Days after feeding.	Died.	Killed.	Results of dissections and remarks.
2	4	--------	*a*, Malpighian tubules with many living premature larvæ.
			b, 2 specimens negative.
4	1	--------	About 4 premature larvæ in Malpighian tubules.
6	--------	2	*a*, 6 premature larvæ (sausage-shaped) in Malpighian tubules.
			b, 4 premature larvæ (sausage-shaped) in Malpighian tubules.
7	--------	2	*a*, 6 premature larvæ (sausage-shaped) in Malpighian tubules.
9	--------	1	4 premature larvæ in Malpighian tubules.
11	--------	2	6 premature larvæ in Malpighian tubules of each specimen.
12	2	4	*a*, 1 mature larva in labium of 1 specimen.
			b, 2 mature larvæ in labium of 2 specimens.
			c, 3 specimens negative.
13	--------	4	*a*, 4 mature larvæ in labia of 2 specimens.
			b, 2 mature larvæ in labium of 1 specimen.
			c, 1 specimen negative.
14	--------	7	*a*, 2 mature larvæ in labia of 6 specimens.
			b, 1 specimen negative.

EXPERIMENT 5; 26 MOSQUITOES, FED SEPTEMBER 3, 1935.

Days after feeding.	Died.	Killed.	Results of dissections and remarks.
2	2	--------	Both negative.
6	1	--------	Negative.
8	--------	3	*a*, 4 premature larvæ (sausage-shaped) in Malpighian tubules.
			b, 5 premature larvæ (sausage-shaped) in Malpighian tubules.
			c, 2 premature larvæ (sausage-shaped) in Malpighian tubules.
9	--------	7	*a*, 6 premature larvæ in Malpighian tubules of 2 specimens.
			b, 4 premature larvæ in Malpighian tubules of 2 specimens.
			c, 8 premature larvæ in Malpighian tubules of 1 specimen.
			d, 2 specimens negative.
10	--------	4	*a*, 5 premature larvæ in Malpighian tubules of 2 specimens.
			b, 6 premature larvæ in Malpighian tubules of 1 specimen.
			c, 1 specimen negative.
11	--------	3	*a*, 3 mature larvæ in labium; 2 mature larvæ in thorax.
			b, 4 mature larvæ in labia of 2 specimens.
13	--------	2	2 mature larvæ in labium of each specimen.
15	--------	4	*a*, 4 mature larvæ in labia of 2 specimens.
			b, 2 specimens negative.

TABLE 1.—*Data from dissections of Culex quinquefasciatus Say infected with Dirofilaria immitis Leidy*—Continued.

EXPERIMENT 6; 26 MOSQUITOES, FED SEPTEMBER 4, 1935.

Mosquitoes dissected.			Results of dissections and remarks.
Days after feeding.	Died.	Killed.	
1	--------	2	Both negative.
2	--------	1	Negative.
4	--------	1	Do.
5	--------	1	4 premature larvæ (sausage-shaped) in Malpighian tubules.
8	1	2	*a*, 5 premature larvæ in Malpighian tubules of 2 specimens.
			b, 3 premature larvæ in Malpighian tubules of 2 specimens.
9	--------	2	6 premature larvæ in Malpighian tubules.
10	--------	1	3 premature larvæ in Malpighian tubules.
11	1	3	*a*, 4 mature larvæ in labia of 2 specimens.
			b, 2 specimens negative.
12	--------	3	Each with 2 mature larvæ in Malpighian tubules.
13	--------	2	*a*, 4 mature larvæ in labium.
			b, 1 mature larva in labium.
14	1	3	*a*, 2 mature larvæ in labia of 2 specimens.
			b, 2 specimens negative.
15	--------	2	*a*, 1 mature larva in labium.
			b, 1 specimen negative.
EXPERIMENT 7; 19 MOSQUITOES, FED SEPTEMBER 5, 1935.			
2	--------	2	Both positive in Malpighian tubules.
4	--------	1	Negative.
5	--------	1	6 premature larvæ (sausage-shaped) in Malpighian tubules.
6	1	2	*a*, 4 premature larvæ (sausage-shaped) in Malpighian tubules of 2 specimens.
			b, 1 specimen negative.
7	--------	2	*a*, 3 premature larvæ in Malpighian tubules.
			b, 5 premature larvæ in Malpighian tubules.
8	--------	1	Negative.
10	--------	1	7 premature larvæ in Malpighian tubules.
11	--------	2	*a*, 2 mature larvæ in labium.
			b, 2 mature larvæ in thorax.
12	--------	2	*a*, 3 mature larvæ in labium.
			b, 1 mature larva in labium.
13	--------	1	4 mature larvæ in labium.
15	--------	2	*a*, 2 mature larvæ in labium.
			b, 1 negative.
16	--------	1	1 mature larva in labium.

TABLE 2.—*Data from dissections of Stegomyia fasciata (Aëdes ægypti Linnæus) infected with Dirofilaria immitis Leidy.*

EXPERIMENT 8; 13 MOSQUITOES, FED SEPTEMBER 7, 1935.

Mosquitoes dissected.			Results of dissections and remarks.
Days after feeding.	Died.	Killed.	
2	--------	2	Both positive in Malpighian tubules; 7 premature in 1 specimen.
4	--------	1	Positive in Malpighian tubules (sausage-shaped) with tail; 5 premature larvæ.
7	--------	1	Positive in Malpighian tubules (advanced sausage-shaped).
11	1	4	*a*, 4 mature larvæ in the heads of 2 specimens. *b*, 6 mature larvæ in the heads of 2 specimens. *c*, 1 specimen negative.
12	--------	1	Negative.
14	--------	1	4 mature larvæ in the thorax; 2 mature larvæ in the head; 14 mature larvæ in the labium.
16	--------	2	Both negative (Malpighian tubules not disintegrated).
EXPERIMENT 9; 12 MOSQUITOES, FED SEPTEMBER 8, 1935.			
10	2	1	*a*, Negative. *b*, Positive in Malpighian tubules (premature larvæ not counted). *c*, 4 mature larvæ in Malpighian tubules (active in normal salt solution).
15	--------	3	*a*, 2 mature larvæ in labium of 1 specimen. *b*, 4 mature larvæ in labia of 2 specimens.
16	--------	4	*a*, 4 mature larvæ in thorax; 2 in head. *b*, 4 mature larvæ in head; 6 in labium. *c*, 4 mature larvæ in labium. *d*, 2 mature larvæ in labium.
17	--------	2	Both negative (Malpighian tubules not disintegrated).
EXPERIMENT 10; 28 MOSQUITOES, FED SEPTEMBER 9, 1935.			
3	1	--------	Positive in Malpighian tubules (sausage-shaped).
4	--------	2	6 premature larvæ in Malpighian tubules of each specimen.
5	--------	2	Both negative.
6	2	2	*a*, 4 premature larvæ in Malpighian tubules. *b*, 7 premature larvæ in Malpighian tubules. *c*, 2 negative.
7	--------	1	5 premature larvæ (advanced sausage-shaped) in Malpighian tubules.
8	--------	1	Negative.
9	--------	2	Both positive; many premature larvæ in Malpighian tubules; not counted.
10	--------	1	4 premature larvæ in Malpighian tubules.
11	1	1	*a*, 4 premature larvæ in Malpighian tubules. *b*, 1 specimen negative.
12	--------	2	*a*, 2 mature larvæ in head. *b*, 8 mature larvæ in labium.
13	2	2	*a*, 2 mature larvæ in heads of 2 specimens. *b*, 3 mature larvæ in head; 2 mature larvæ in labium.
14	--------	1	2 mature larvæ in labium.
15	1	2	*a*, 4 mature larvæ in labium; 2 mature larvæ in heads of 2 specimens. *b*, 1 specimen negative.
16	--------	1	Negative (Malpighian tubules not disintegrated).
17	--------	2	Negative in thorax, head, and labium; Malpighian tubules disintegrated.

TABLE 2.—*Data from dissections of Stegomyia fasciata (Aëdes ægypti Linnæus) infected with Dirofilaria immitis Leidy*—Continued.

EXPERIMENT 11; 18 MOSQUITOES, FED SEPTEMBER 10, 1935.

Mosquitoes dissected. Days after feeding.	Died.	Killed.	Results of dissections and remarks.
1	--------	2	Both positive in Malpighian tubules.
3	--------	1	4 premature larvæ in Malpighian tubules.
4	1	1	*a*, 4 premature larvæ in Malpighian tubules.
			b, 1 specimen negative.
6	--------	2	Both negative.
8	--------	2	Positive in Malpighian tubules in both specimens (calcified).
10	1	1	*a*, 6 premature larvæ (advanced sausage-shaped) in Malpighian tubules.
			b, Negative.
11	--------	1	1 mature larva in thorax; 2 mature larvæ in head.
12	--------	2	*a*, 2 mature larvæ in labium.
			b, 4 mature larvæ in labium.
13	--------	1	4 mature larvæ in head.
14	--------	2	*a*, 1 mature larva in thorax.
			b, 3 mature larvæ in head.
15	--------	1	4 mature larvæ in labium.
EXPERIMENT 12; 12 MOSQUITOES, FED SEPTEMBER 11, 1935.			
3	1	2	*a*, Positive in Malpighian tubules of 2 specimens (calcified).
			b, 1 specimen negative.
4	--------	2	Both positive in Malpighian tubules; larvæ not counted.
6	1	3	*a*, 6, 4, and 9 premature larvæ, respectively, in Malpighian tubules of 3 specimens.
			b, 1 specimen negative.
7	2	3	*a*, Positive in Malpighian tubules of 3 specimens; many larvæ (sausage-shaped) not counted.
			b, 2 specimens negative.
9	--------	2	Both positive in Malpighian tubules (calcified).
10	1	2	*a*, 5 premature larvæ (about to escape) in Malpighian tubules of 1 specimen.
			b, As in *a*, but with 7 premature larvæ.
			c, 1 specimen negative.
11	1	1	*a*, 2 mature larvæ in head; 2 mature larvæ in thorax.
			b, 1 specimen negative.
13	--------	1	4 mature larvæ in head.
14	--------	2	2 mature larvæ in head of each specimen.
15	--------	1	4 mature larvæ in head.

ILLUSTRATION

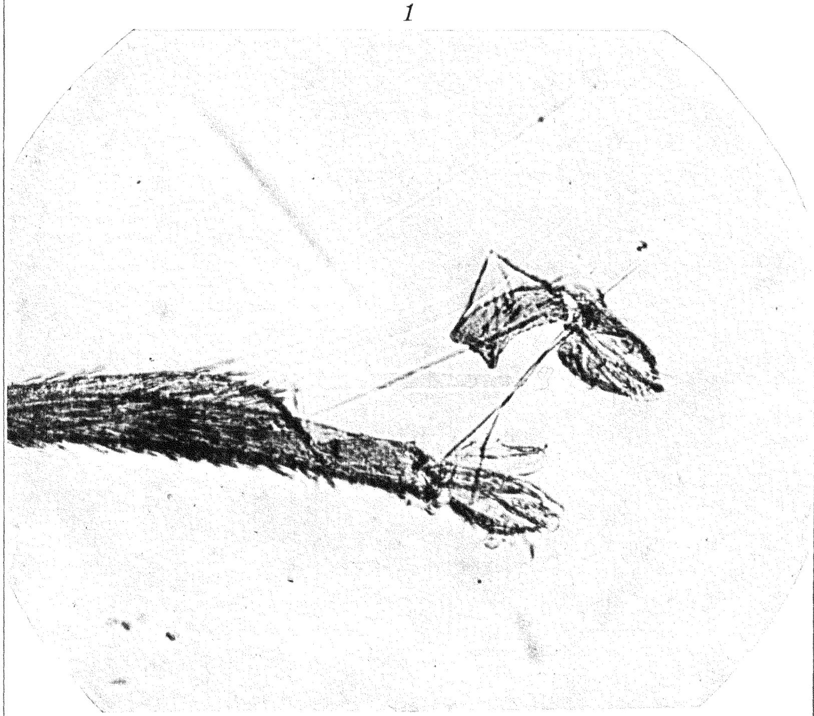
[Photographs by the Department of Agriculture and Commerce.]

PLATE 1

FIG. 1. *Dirofilaria immitis* Leidy, premature larvæ, in a small portion of the Malpighian tubules of *Culex quinquefasciatus* Say.

2. *Dirofilaria immitis* Leidy, mature larvæ, in the proboscis of *Culex quinquefasciatus* Say.

1



2

PLATE 1.

SCOLYTIDÆ AND PLATYPODIDÆ: FAUNA PHILIPPINENSIS, IV [1]

By KARL E. SCHEDL

Of the Institut für angewandte Zoologie, Munich, Germany

FIVE TEXT FIGURES

PITYOPHTHORUS PHILIPPINENSIS sp. nov.

Reddish brown, 1.8 mm long, 2.6 times as long as wide. A species which most probably (after the other sex is found) has to be placed in the fourth group of Blackman's key. The first species of the genus recorded from the Philippine Islands.

Front plano-convex, very densely and finely punctured, with a fine, elevated median carina. Antennal club long oval, widest through the second segment, with the two septate sutures well developed.

Pronotum as wide as long, widest in the basal third, base distinctly bisinuate, posterolateral angles rounded, sides arcuate and convergent in the basal half, thence strongly constricted, rather narrowly rounded in front; anterior margin armed with several subequal, low asperities, anterior area steep and asperate, asperities scattered, not fused at their base, posterior area densely and coarsely punctured, transverse depression distinct, median line impunctate and feebly elevated. Scutellum large, shining.

Elytra as wide and nearly twice as long as the pronotum, sides parallel on the anterior two-thirds, broadly rounded behind; cylindrical disc shining, punctured in distinct rows, the first ones impressed, interspaces wide, finely reticulate, with small scattered punctures; declivity commencing far behind the middle, convex, suture narrowly elevated and with a row of fine granules, second interspace wide, broadly impressed, shining, subimpunctate, lateral convexities lower than the suture and also with a few small setose granules.

Type in my collection.

LUZON, Manila, 1908 (*Raszlag*).

[1] Thirty-seventh contribution to the systematics of the Scolytidæ and Platypodidæ of the world.

CRYPTOXYLEBORUS EGGERSI sp. nov.

Female.—Reddish brown, 4.5 mm long, 3.1 times as long as wide. Similar to *C. turbineus* Samps. but larger, the elytra with a transverse depression about in the middle and more coarsely sculptured.

Front plano-convex, subshining, minutely areolate, coarsely punctured, median carina long and fine, extending to the upper margin of the eyes.

Pronotum longer than wide (17 : 15), widest before the middle, base broadly arcuate, posterolateral angles strongly rounded, sides straight, somewhat divergent towards the anterior third, apex very broadly rounded, summit far in front of the middle, anterior area moderately convex, finely asperate, posterior portion shining, rather densely and finely punctured, entire surface with yellow pubescence.

Elytra at the base distinctly narrower (15 : 14) and 1.4 times as long as the pronotum, humeral angles rectangular, rather strongly rounded, sides straight but convergent up to the posterior third, then angulate and drawn out into a slender process at the apex; cylindrical, with a transverse depression at about the middle, the declivity oblique and similar to that of *C. turbineus* Samps.; disc densely and rather confusedly punctured, the first and second striæ impressed, the punctures not quite in distinct regular rows, the first interstice very narrow throughout, the second with a row of shining, backwardly directed tubercles, which commence at the anterior third of the elytra and continue to the apex, largest at the summit of the declivity, the third interstice with a similar row but more weakly developed, the remaining interstices with small tubercles on the declivity, at the apex on the first and second interstices with a larger, slender, toothlike tubercle, those of the first interstice being longer; the interstices of the entire elytra shining, with long yellow pubescence, on the declivity the first and second striæ rather distinctly punctured and impressed.

Types in the collections of Eggers and Schedl.

MINDANAO, Kolambugan, January 25, 1915 (*Böttcher*).

Genus PSEUDOXYLEBORUS Eggers

Examining the type, *Pseudoxyleborus beesoni* Egg., I find some facts that make it necessary to revise the generic diagnosis. The species of the genus *Xyleborus* that hitherto have been regarded as rather closely related and have been grouped around *Xyleborus truncatus* Er. show striking differences if the antenna

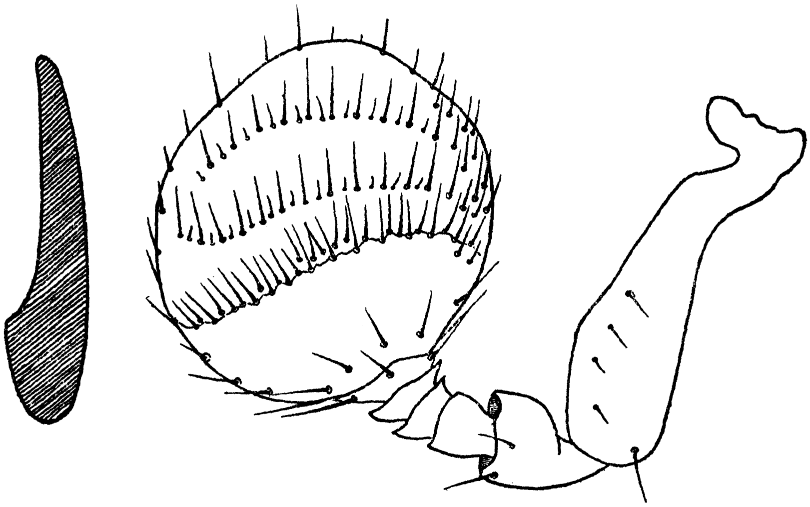


FIG. 1. *Xyleborus truncatus* Er., antenna.

is carefully studied. *Xyleborus truncatus* Er. (fig. 1) and *X. striatotruncatus* Schedl have the antennal club moderately compressed, very obliquely truncate, and with two widely separated sutures; *X. mancus* Blandf. (fig. 2) and *X. abruptus* Samps.

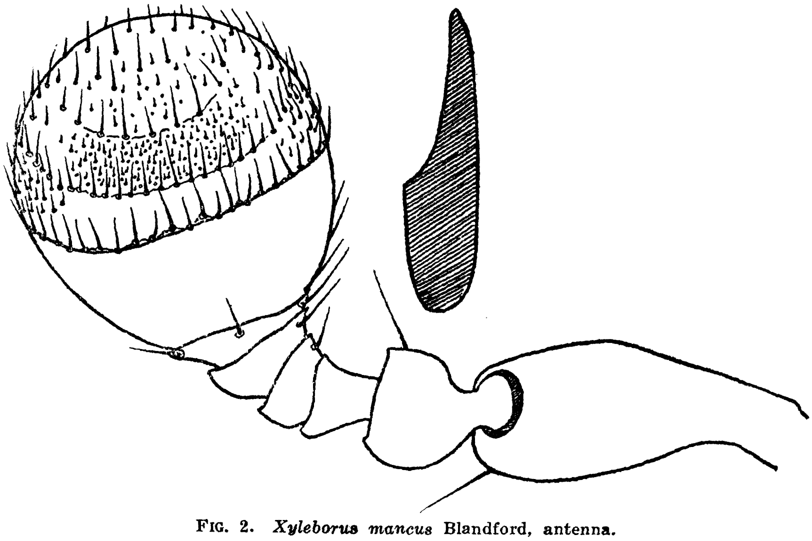


FIG. 2. *Xyleborus mancus* Blandford, antenna.

have the club less compressed, steeply, and obliquely truncate, and the suture near the wide basal piece. It is quite likely that the examination of more species of this group will bring to light intermediate forms so that they finally cannot be separated by

the antennæ alone. More striking differences are shown by *Pseudoxyleborus beesoni* (fig. 3) and some allied species.

The antennal funicle is not 4-jointed as stated by Eggers, but has five segments like all Xyleborinæ. The pedicle is large, the second segment about as long as wide, the others gradually increasing in width; the club subcircular, strongly compressed, more strongly so distally, without visible sutures, the external face densely covered with short pubescence. The eyes are either entirely separated into two parts or connected by a single row of facets or a simple suture only. Of the species examined the following belong to this genus: *Xyleborus nobilis* Egg., *X. aspersus* Samps., *X. opalescens* Schedl, and *X. corthyloides* Schedl. Doubtless many more of the described species will have to be referred to this genus, the validity of which I regard as beyond question.

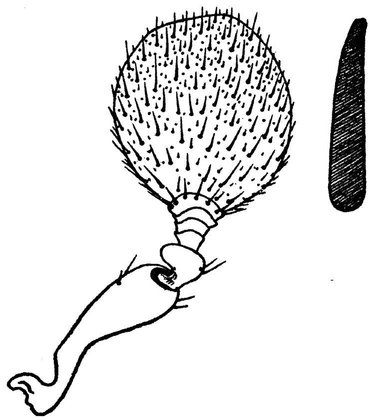


FIG. 3. *Pseudoxyleborus beesoni* Egg., antenna of the type.

GENERA WEBBIA HOPKINS AND XYLEBORICUS EGGERS

For a time I had doubts concerning the relationship of *Webbia* Hopk. and *Xyleboricus* Egg. Lately Mr. Eggers kindly placed his entire material at my disposition, and after examining it I am in a position to give some revisional notes. The antenna, the main character for distinguishing the two genera, has been examined in the following species: *Xyleboricus talauticus* Egg., *X. mediosectus* Egg., *X. canaliculatus* Egg., *X. pusillus* Egg., *Webbia pabo* Samps., *W. 18-spinatus* Samps., *W. sublævis* Egg., *W. medius* Egg., *W. imitator* Egg., *W. platypoides* Egg., *W. confinis* Egg., *W. mucronatus* Egg., *W. minor* Egg., *W. marginatus* Egg., and *W. nitidus* Egg.

Genus **WEBBIA** Hopkins

Female.—Body elongate, cylindrical, resembling certain species of the Platypodidæ, head concealed by the long cylindrical, anteriorly feebly convex pronotum, eyes oblong, elliptical, emarginate in front, antenna (fig. 4) with the funicle 4-jointed, the club from circular to short oval in outline, with an obliquely

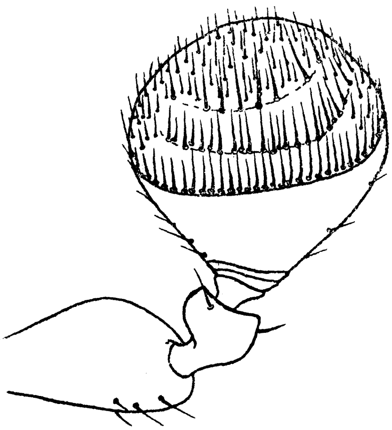


FIG. 4. *Webbia platypoides* Egg., antenna.

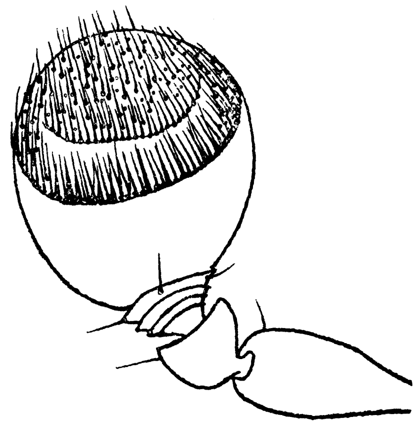


FIG. 5. *Xyleboricus confinis* Egg., antenna.

truncate face, the basal and the internal face strongly chitinized, the oblique truncate face with two more or less distinct sutures, usually formed by rows of closely placed setæ; anterior tibiæ strongly narrowed distally, with a submarginal row of small, densely placed teeth on the ventral side; elytra cylindrical, usually with remarkable declivital armature.

Male.—As far as known smaller than the female, probably of similar relative characters as in the genus *Xyleborus*.

From the general shape of the body it can be concluded that all members of the genus are true ambrosia feeders. Besides the type, *Webbia dipterocarpus* Hopk., I refer the following species to this genus: *Webbia pabo* Samps., *W. 18-spinatus* Samps., *W. 30-spinatus* Samps. (antennæ not examined), *W. 26-spinatus* Samps. (as before), *W. platypoides* Egg., *W. mucronatus* Egg., *W. dentatus* Egg. (antennæ not examined), and *W. talauticus* Egg.

Genus XYLEBORICUS Eggers

Body short cylindrical to oval in outline, head concealed by the pronotum, eyes long oval, strongly emarginate in front, antennæ with the funicle 5-jointed (not 2-jointed as is stated in the original description), club subcircular in outline, obliquely truncate as in *Webbia* Hopk., sutures more or less distinct on the oblique face, anterior tibiæ very feebly widened at the middle, narrowed distally, outer edge with a row of submarginal teeth; pronotum with the summit far in front of the middle, moderately convex, cylindrical behind, more so than in the genus *Xyleborus;* elytra cylindrical, declivity convex, in the majority

of the species with the interstices narrowly carinate and finely tuberculate.

The species described are apparently all females; the type of the genus is *Xyleboricus canaliculatus* Egg.

The value of the genus and its relationship to the large genus *Xyleborus* are rather difficult to interpret at present. The few specimens available do not allow dissection and examination of the mouth parts, proventriculus, and genitalia. The following species have to be referred to this genus: *Xyleboricus mediosectus* Egg., *X. orbiculatus* Egg., *X. malayensis* Schedl, *X. dissimilis* Egg., *X. similis* Egg. (I did not have an opportunity to examine the antennæ of the last two species), *Webbia medius* Egg., *W. imitator* Egg., *W. minor* Egg., *W. marginatus* Egg., *W. confinis* Egg., *W. sublævis* Egg., *W. tuberculatus* Egg., and *W. pusillus* Egg.

Webbia nitidus Egg. has been misplaced also. It has the antennal funicle 5-jointed, the club circular, strongly compressed, not obliquely truncate, and without noteworthy sutures. I shall give more information in another paper.

XYLEBORUS MARGINICOLLIS sp. nov.

Female.—Reddish brown, 1.4 mm long, 2.1 times as long as wide. This small species has to be placed in the neighborhood of *X. quadrispinosulus* Egg., with which it coincides in the general shape; distinguishing characters are the lack of tubercles on the declivity and the sculpture of the pronotum.

Front convex, shining, polished and sparsely but coarsely punctured below; subshining and finely and densely punctulate above, along the median line feebly elevated. Eyes short oval, emarginate in front. Pronotum wider than long (23: 18), widest near the base, the latter transverse, posterolateral angles rounded, sides strongly arcuate and convergent from the base to the moderately rounded apex, anterior margin armed with several asperities, the median two feebly longer, surface strongly globose, summit at the middle, anterior area steep, covered with asperities, posterior area shining, very sparsely and finely punctured.

Elytra but little wider and 1.5 times as long as the pronotum, sides subparallel, feebly arcuate, broadly and somewhat angulately rounded behind, ascending and convex on the basal third, obliquely rounded, rather strongly flattened on the declivity; disc shining, with hardly noticeable rows of fine punctures, interspaces wide and subimpunctate; the punctures coarser, the striæ

distinct and the suture feebly elevated on the flattened declivity, the apical margin acute.

Type in my collection.

LUZON.

XYLEBORUS LIMATUS sp. nov.

Female.—Reddish brown, 1.7 mm long, nearly three times as long as wide. Related to *X. lævis* Egg. but much smaller and with other sculpture.

Front convex, shining, sparsely and coarsely punctured, especially on the sides, towards the eyes. Eyes short oval, shallowly emarginate in front.

Pronotum longer than wide (23 : 20), base transverse, posterolateral angles rounded, sides parallel on more than the basal half, thence feebly constricted, broadly rounded in front, summit before the middle, anterior area finely asperate, feebly convex, basal area shining, with scattered fine punctures. Scutellum small, triangular.

Elytra as wide and 1.5 times as long as the pronotum, sides parallel, broadly rounded behind, shallowly and triangularly emarginate at the suture; cylindrical on the basal half, gradually and obliquely convex on the declivity; disc shining, punctured in distinct rows, punctures small, rather remotely placed, interspaces somewhat reticulate, with smaller, scattered punctures; declivity with the suture and the third interstice elevated and with a row of setose granules, first and second striæ with coarse punctures and feebly impressed, second interstice very narrow, irregularly and densely punctured laterad to the third interstice, apical margin very acute, minutely serrate, the entire declivity appearing subopaque.

Type in my collection.

LUZON, Laguna Province, Mount Maquiling, July 29, 1932 (*F. C. Hadden*).

PLATYPUS EXCEDENS Chap.

Female.—Reddish brown, 3.2 mm long, 3.6 times as long as wide.

Front shining and concave below, subshining, flattened and densely and finely areolate above, the concavity with a strongly elevated but narrow median carina in the upper half, surface peculiarly areolate-wrinkled. Antennæ inserted just below the eyes, articulation very distant from that of the mandibles, antennal scape strongly flattened, compressed, much wider than

long, broadly oval in outline. Vertex separated from the front by a subacute angle.

Pronotum longer than wide (10 : 8.5), femoral grooves hardly visible from above, median sulcus very long, feebly developed, surrounded by a cordiform patch of fine, densely placed punctures on its anterior half, the anterior limits of this patch usually surrounded by a more or less distinct line, surface shining, sparingly punctured.

Elytra about as wide and nearly twice as long as the pronotum, sides parallel, conjointly and broadly rounded behind; disc punctured in fine rather regular rows, somewhat impressed towards the base, interstices subshining, with fine scattered punctures, base of the second to fourth with fine, densely placed tubercles; declivity moderately convex, commencing in the apical fourth, finely granulate, with short yellow pubescence.

This is the first description of the female. Types in Mr. Hadden's collection and in my own.

LUZON, Laguna Province, Mount Maquiling, July 26, 1932 (*F. C. Hadden*).

DIAPUS PLUMATUS sp. nov.

Female.—Yellowish brown, 3.2 mm long, nearly three times as long as wide. This species is well characterized by the sculpture of the front and pronotum.

Front subshining, long, subrostrate below, with a triangular, shining, elevated ridge extending from the articulation of the mandibles to the center, the inclosed area ornamented with a plush of very long (twice as long as the head when viewed from above), slender, forward directed hairs, articulation of the antennæ in the middle of the front, narrowed and situated between the eyes, antennal scape slender and feebly club-shaped, genæ subimpunctate, posterior half of the front (above the insertion of the antennæ) minutely punctured, rounded towards the vertex, the latter long and opaque, with a transverse row of coarse punctures anteriorly, the median line narrowly elevated and shining.

Pronotum polished, longer than wide (11 : 9), widest at the posterior angles of the femoral grooves, much narrower anteriorly to the latter, median sulcus indicated as a fine dark line, with three large pores on each side of its anterior extremity, surface subimpunctate. External face of the anterior tibiæ with numerous, fine, transverse rugosities.

Elytra as wide and 1.6 times as long as the pronotum, sides parallel, each elytron somewhat separately rounded posteriorly,

rather flat as a whole, with hardly visible rows of punctures, the first three interstices feebly elevated near the base, declivity feebly developed, hardly convex, with few long hairs; abdomen convex, ascending.

Type in my collection.

Philippines; as I received it from Mr. Hadden, it likely was collected in Luzon.

DIAPUS MULTIPORUS sp. nov.

Female.—Head and pronotum fuscous, elytra yellow, apex darker, 5.6 mm long (without the projecting abdomen), four times as long as wide. A remarkable species.

Front flat, with a broad, medially divided plush of long, curled reddish hairs arising from the epistomal margin and a similar inward curled fringe on the sides on the inner margin of the eyes, the ends of the latter meet in the center, the high flat area between those plushes, as far as can be seen, polished; eyes in the upper half of front, articulation of antennæ on the upper inner edges of the eyes, remaining portion of front plano-convex, rounded towards the vertex, the latter with rather long, subshining, elevated median line.

Prontum longer than wide (15 : 13), femoral grooves shallow, base strongly bisinuate, median sulcus indicated as a long dark line, on most of its length accompanied on both sides by a wide subquadrate area which is densely covered with medium-sized pores, remaining surface subshining, subimpunctate, along the apical border with a row of coarse punctures.

Elytra feebly wider than and 1.6 times as long as the pronotum, sides parallel, posteriorly hardly convex, each elytron feebly and separately rounded, strial punctures hardly noticeable, feebly impressed, interstices feebly convex near the suture and base, subimpunctate. Abdomen projecting far beyond the elytra, the spiracles on the last segment very large, the last sternite nearly as long as the others together.

Type in my collection.

Philippine Islands, from alcoholic material.

ILLUSTRATIONS

TEXT FIGURES

CHIRONOMIDÆ FROM JAPAN (DIPTERA), VII

NEW SPECIES AND A NEW VARIETY OF THE GENUS CHIRONOMUS MEIGEN [1]

By MASAAKI TOKUNAGA

Of the Entomological Laboratory, Kyoto Imperial University, Japan

FOUR PLATES

The chironomid flies reported in the present paper were collected entirely at Seto, Wakayama Prefecture, Japan, near the Marine Biological Station of the Kyoto Imperial University. Some of them were reared from the larvæ in the laboratory. There have been reported, so far as known, the following six salt-water dwelling species of the genus *Chironomus* (sen. str.): *Chironomus halophilus* Kieffer, *bicornutus* Kieffer, *salinarius* Kieffer, *halochares* Kieffer, *aprilinus* Meigen, and *barbipes* Staeger. To these I am adding two new species and one new variety.

I am greatly indebted to Prof. Dr. Hachiro Yuasa and Prof. Dr. Yô K. Okada for their kind help in this study.

CHIRONOMUS (CHIRONOMUS) ENTEROMORPHÆ sp. nov.

This species is very common ashore at Seto. The specimens examined were reared from the larvæ collected at the tide pools where the green alga *Enteromorpha intestinalis* was luxuriant.

According to the taxonomic system of Edwards (1929) this species obviously belongs to series 2 of group B of the subgenus *Chironomus*, possessing pubescent dorsal appendages. All other known salt-water species of *Chironomus* belong to series 1, being provided with bare chitinized dorsal appendages.

In the pupal stage the apical teeth or spines of the eighth abdominal segment have been regarded as one of the most important taxonomic characters, being comparatively constant in structure for the species; however, it is noteworthy that they show wide variation in the present species, as shown in the figures (Plate 1, figs. 2 to 5).

[1] Contributions from the entomological laboratory, Kyoto Imperial University, No. 51. Contribution from the Seto Marine Biological Laboratory, Kyoto Imperial University.

Male.—Body slender, length about 3.5 to 4 mm; thorax yellowish brown, with brown dorsal stripes; abdomen brown.

Eyes not widely separated above, with long dorsal projections around the antennal bases; distance between them on the dorsal side subequal to that of the ventral side, the ratio being 9 : 22 to the vertical length of the eyes; dorsal apex of vertex with a conspicuous V-shaped incision in the frontal aspect; frontal tubercles distinct; antennæ 12-segmented, antennal ratio about 1 (20 : 19); maxillary palpi distinctly 4-segmented (3 : 5 : 8 : 12); clypeus setigerous with brown setæ.

Pronotum narrow, with a small median incision; scutum with three rows of small setæ; supra-alar setal group represented by six to eight small setæ; humeral pits obscure; scutellum setigerous, pale brown; postscutellum black, with a T-shaped yellow stripe.

Abdomen yellowish brown, without specially colored bands; hypopygium (Plate 1, fig. 1) pale brown; ultimate tergum very scantily haired with several setæ on its meson and with small setæ on the caudal margin; anal point well developed, chitinized, bare, not trilobate apically; coxite with five to seven slender setæ on its ventromesal margin; style slender, with several stiff setæ on its apex and about ten small, slender setæ on the distal half of its fleshy dorsal ridge; dorsal appendage short but broad, not beyond the tip of the coxite, entirely pubescent, with two to four apical setæ and a bare chitinized hook, which is ventrally curved; ventral appendage large, straight, far beyond the middle of the style, fully reaching the tip of the anal point, provided with many, strong, curved setæ on its distal part.

Legs yellowish brown; coxæ reddish brown; femur, tibia, and ultimate segment of tarsus somewhat darker; foreleg without trace of tibial spur and comb; leg ratio about 1.6 to 1.7; middle and hind tibiæ each provided with two distinct confluent combs, which occupy about four-fifths of the circumference of the tibial tip; each comb with a short spur; claws slender, simple; empodium slender; pulvilli well developed, padlike, as long as the claws themselves.

Wings about 2.5 mm long, hyaline, very slightly ochraceous under transmitted light, without colored marks on the membrane; main veins brown; r-m very short, oblique, not obviously darkened; R_{2+3} ending on costa a little beyond the end of R_1; fCu slightly beyond r-m; 1A beyond fCu; R and R_1 setigerous. Haltere yellow.

Female.—Body subequal in length to that of the male; abdomen and wings broader than in the male, but subequal in length to those of the male; coloration as in the male. Apical incision of the vertex not so deep as in the male; relative lengths of the four segments of the maxillary palpus 3 : 6 : 10 : 14; antennæ 6-segmented (4 : 6 : 4 : 4 : 4 : 10); ultimate segment elongated, with a small apical seta; second segment somewhat elongated, slightly constricted at middle; following three segments short, fusiform, without distinct neck regions. Leg ratio about 1.5 to 1.7. Ultimate sternum broad, setigerous, with a U-shaped caudal incision, with a median, shallow, longitudinal furrow, without special long setæ on its margin; cerci short, small, rhombic; cercaria (small lunate sclerite at the articulation of the cercus) with two small setæ; spermathecæ two, hyaline, oval. Wings setigerous on veins R, R_1, and R_{4+5}.

Other characters of the head, thorax, legs, wings, and abdomen closely similar to those of the male.

Pupa.—Body about 5 to 6 mm long, female slightly larger than male; exuviæ hyaline, ochraceous; genital sheaths of female smaller than those of male, located under ultimate segment, not visible from dorsal aspect, those of male large, extending beyond ultimate segment.

Sheaths of frontal tubercles large, almost straight, not curved ventrad, with a simple seta and three minute chitinized projections on each tip; antennal sheath ending in a specially thickened thornlike tip. Prothoracic respiratory appendages grouped in two bunches at base. Abdomen (Plate 1, fig. 6) scantily setigerous; dorsum typically with two pairs of setæ on meson and three setæ on either lateral part; venter with one pair of setæ on caudomeson and four setæ on either lateral part; latus typically with four setæ; these lateral setæ on cephalic four segments small, ordinary in shape, usually less in number, being one to four, while those on caudal segments are very long and flattened; caudal four segments, from fifth to eighth, with lateral, lamella-like, chitinized expansions; dorsum of the abdominal segments from second to sixth finely spinulose with minute spinules (Plate 1, fig. 8); dorsocaudal margin of second abdominal segment provided with a comblike structure, consisting of a single row of hooklike spinules (Plate 1, fig. 7); laterocaudal corners of fourth sternum with spinulose patches (Plate 1, fig. 9); apex of lateral margin of eighth segment with small yellow teeth, which vary widely in number (2 to 6) and shape (isolated or united), as shown in Plate 1, figs. 2 to 5; lateral, fanlike, chiti-

nized expansions of ultimate segment ordinary in structure, being fringed with hyaline, flattened, swimming hairs; each lateral half of these expansions with more hairs (53 to 58) in the female than in the male (38 to 40), and in both sexes provided with an isolated brown seta; dorsum of nonspinulose segments showing fine reticulation.

Larva.—Body blood red in life, 9 to 10 mm long in full-grown specimens, without lateral gill filaments on caudal segments; anal gills greatly reduced as in the halobiotic species of *Chironomus* in general.

Head capsule reddish brown, smooth in general appearance; antennæ slightly shorter than mandibles, 5-segmented (30 : 6 : 4 : 4 : 2), with a minute sensory pore on proximal part of first segment; trichoid sensillæ two on antenna: A long large one, which is equally bifurcate and subequal in length to second and third segments taken together, on distal end of first segment, and a small one, which is simple and subequal in length to third segment itself, on distal end of second segment; clypeal region consisting of a large preclypeal sclerite and lateral membranous parts, provided with three pairs of large tuberculate setæ as in the Chironominæ in general; labrum membranous, with many various appendages as shown in Plate 2, fig. 15; of these appendages the mesal three pairs provided with their independent chitinized basal rings, ventromesal comblike pair hyaline and triangular; labralia with a hyaline seta near articulation of premandible; epigusta with paired bunches of serrate hooks inside the U-shaped sclerite and a strongly chitinized comblike plate, which is distinctly serrate into eight or eleven teeth just caudad of paired comblike plates of the labrum; unpaired, small, chitinized plate located just caudad of the U-shaped sclerite; premandibles (Plate 2, fig. 16) comparatively slender, tridentate; membrane near the base of premandible swollen and densely spinose.

Mandibles comparatively slender, distinctly serrate into four stout dark, cutting teeth and one slender, brown, distal tooth; proximal brustia consisting of tufts of hyaline branched filaments; distal brustia consisting of comparatively long setæ arranged in a single row; one isolated hyaline seta, which is short, hardly reaching tip of most proximal tooth located on cutting edge; maxillæ (Plate 1, fig. 12) supported by well-developed chitinized plate on ventral side; two very long setæ on meson of this broad ventral plate; both cardo and stipes comparatively well developed; inner lobe of maxilla (lacinia) large, membra-

nous, provided with various sensory organs and brown thornlike and fingerlike projections on its distal margin; outer lobe of maxilla small, with two sensory setæ and comparatively large maxillary palpus; maxillary palpus provided with many sensillæ on its distal end and a small sensory pit on the ventrodistal part; segmentation of the maxillary palpus obscure, probably 3-segmented including the ultimate, minute, conical structure; mentum with thirteen teeth as shown in Plate 2, fig. 13; unpaired median tooth largest, not sharply pointed; innermost paired teeth large, extending as far as median tooth, also not sharply pointed; next lateral pair small, smaller than following lateral pair, sometimes appearing as a blunt shoulder of innermost pair; other pairs of lateral teeth more or less pointed, gradually decreasing in size laterad; lateral fanlike lamellæ of mentum comparatively small, somewhat triangular, finely striated radially; one long isolated seta near the base of this fanlike lamella; hypopharyngeal projection (Plate 2, fig. 14) membranous, with thornlike appendages and scalelike hyaline projections on its margin; common salivary duct very short; accessory chitinized endoskeletons as shown in fig. 14.

Setæ of body, excepting the caudal tufts, slender and weakly developed; anterior pseudopods well developed, provided with numerous, golden yellow, thornlike spinules on fleshy bilobate projections; those spinules on distal part long, slender, very finely serrate only on tip, while the great majority of spinules on other parts are short, stout, and finely serrate on the distal half; united proximal part and dorsocephalic surface of anterior pseudopods without spinules and setæ, being quite smooth; posterior pseudopods well developed, long, each crowned with fifteen yellowish brown thornlike hooks, which are radially arranged in three rows: Six on outer proximal, five on middle, and four on inner distal semicircular row (Plate 1, figs. 10 and 11); paired caudal tufts situated close to each other; each tuft consisting of eight, long, slender setæ and two, small, tuberculate setæ on each basal papilla.

Habitat.—*Enteromorpha* tide pool, upper tidal zone, Japan.

Holotype.—Male; Seto, Wakayama Prefecture; June 27, 1930.

Allotopotype.—Female; Seto, Kakayama Prefecture; June 27, 1930.

Paratopotypes.—Males and females; Seto, Wakayama Prefecture; June 27, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

This species resembles *Ch. longipes* Staeger and *Ch. dissidens* Walker in the structures of the hypopygium, but distinctly differs from each of the related species in the structure of the dorsal appendages of the hypopygium, in the coloration of the wing veins, and in the different value of the leg ratio.

CHIRONOMUS (CHIRONOMUS) ENTEROMORPHÆ var. PACIFICUS var. nov.

This variety was reared from the larvæ found in rock tide pools at the upper tidal line at Seto.

Male.—Body about 6 mm long, ground color brown.

Frontal tubercles small; eyes very narrowly separated from each other on the dorsal side; distance between them about two-sevenths as great as the vertical length of the eyes themselves; antennæ 12-segmented; antennal ratio about 1.1; maxillary palpi 4-segmented (3 : 5 : 10 : 12). Thorax with three brown scutal vittæ, of which the median one is subdivided by a pale median line; sternal side of the mesosternepisternum brown; pleural side with three brown spots near the wing base; scutellum pale brown, setigerous, brown only on its lateral margins; postscutellum brown, with a T-shaped pale pattern. Abdomen uniformly brown. Hypopygium (Plate 3, fig. 22) setigerous, similar in structure to that of *Chironomus enteromorphæ* Tokunaga, but slightly differing in the following points: Ultimate tergite more setigerous, dorsal appendages longer, ventral appendages with two or three almost straight setæ in addition to strong recurved setæ on tip, and styles broader. Leg ratio about 1.5; proportional lengths of the five tarsal segments of forelegs 60 : 30 : 25 : 19 : 10. Wings with pale brown crossvein; fCu under r-m. Halteres yellow.

Habitat.—Salt water; Japan.

Holotype.—Male; Seto, Wakayama Prefecture; April 23, 1928.

Paratopotypes.—Males; head, forelegs, and hypopygium mounted in euparal; April 23, 1928.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by Prof. Dr. H. Yuasa.

This variety is closely allied to the type form, from which it slightly differs in the structure of the hypopygium, in the wing venation, in the proportional lengths of the segments of the maxillary palpi, and in the value of the leg ratio.

CHIRONOMUS (CHIRONOMUS) KIIENSIS sp. nov.

This species is commonly found at Seto and females are often captured at light ashore in summer.

Male.—Body slender, ground color yellow, about 5 mm long.

Frontal tubercles present, small; antennæ 12-segmented, brown; second antennal segment yellow, but its distal end brown; antennal ratio about 3.2 to 3.3; maxillary palpi distinctly 4-segmented (3 : 7 : 7 : 11); last maxillary palpal segment yellow; frontoclypeus with many long brown setæ.

Scutum with distinct reddish brown vittæ; median vitta with a longitudinal, pale, median line; pale posterior region of the scutum with a fine, dark, median line; scutellum yellow, setigerous, its lateral margins brown; sternal side of the mesosternepisternum reddish brown; mesonotepisternum, mesonotepimeron, and mesosternepimeron each with a reddish brown spot near base of wing articulation; supra-alar setal group represented by five to seven small setæ.

Abdomen slender, yellowish; first tergum with two pairs of brown stripes: mesal pair small and lateral pair long and oblique; second to fourth terga each with a median I-shaped brown stripe; following three terga entirely brown, stripes being obscure, each with a brown V-shaped chitinization on its meson. Hypopygium (Plate 3, fig. 23) brown, setigerous; ultimate tergum with a small, oval, setigerous plate and V-shaped chitinization on meson; its caudal setæ near basis of anal point slender; anal point strongly chitinized, bare, curved ventrad, not trilobed apically; coxites slightly constricted, each with five slender setæ on its ventromesal ridge; styles distinctly narrowed on apical one-third, each provided with six, small, strong setæ on apex and about thirteen, small, slender setæ on ventral ridge of style; dorsal appendages large and slender, not extending to tip of anal point, bare, strongly curved ventrad, each with a few setæ on its basal pubescent area; ventral appendages large and straight, extending far beyond middle of styles, provided with many, strong, recurved setæ and a few slender setæ on apical one-third.

Legs yellow in ground color; coxæ and trochanters brown; femora each with a distinct brown ring just before distal tip; two distal segments and distal ends of three proximal segments of each tarsus reddish brown; forelegs without tibial spurs; each tibia of the middle and hind legs provided with two basally fused combs, which occupy about three-fourths the circumference of tibial end; two tibial combs each provided with a small spur; fore tarsal segments have the following proportional lengths: 80 : 45 : 30 : 24 : 12; leg ratio 1.7 to 1.8; claws simple; empodium slender, setigerous; pulvilli large, padlike, setigerous, extended distad far beyond middle of claws.

Wings slightly clouded; two elongated nebulæ in cell R_5, a narrow nebula in cell M_2 along vein M_{1+2}, narrow nebulæ along veins M_{3+4}, Cu_1, 1A, and 2A; r-m distinctly darkened; fCu beyond the crossvein; R_{2+3} extended closely along R_1, ending slightly distad of the end of R_1; Cu_1 and 1A slightly sinuous on distal parts; R, R_1, and R_{3+4} brown, setigerous. Halteres yellow.

Female.—Body about 3 to 5 mm long; coloration similar to that of the male; abdomen entirely pale brown, sometimes with paired, pale yellow, longitudinal stripes through the terga from the second to seventh segments. Antennæ 6-segmented (4 : 7 : 6 : 6 : 6 : 10); intermediate segments each with a distinct neck region; ultimate segment brown, with one apical seta; maxillary palpi 4-segmented (2 : 8 : 10 : 11 or 2 : 6 : 8 : 12). Leg ratio 1.8 to 1.9; proportional lengths of the fore tarsal segments 90 : 45 : 35 : 32 : 15. Hypopygium (Plate 4, fig. 29) brown; ultimate sternum slightly dark, subdivided into paired setigerous plates by the median shallow furrow, with a shallow, U-shaped, caudal incision; octavalvæ bilobate; lateral lobe fleshy, very small, spinulose with minute spinules; cerci comparatively large, discoidal, not angulate or pointed caudad; spermathecæ two, comparatively large, almost spherical.

Habitat.—Fresh water (?); Japan.

Holotype.—Male; hypopygium and fore tarsus mounted in euparal; Seto, Wakayama Prefecture; June 24, 1930.

Allotopotype.—Female; June 24, 1930.

Paratopotypes.—Females; hypopygium mounted in euparal; June 21 and 26, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species is distinctly characteristic in the possession of the nebulose wings, and, except for this character, closely related to certain Sumatran species, *Ch. javanus* Johannsen and *Ch. costatus* Johannsen, from which it differs in the coloration of the thorax and legs and in the proportional lengths of the third and fourth tarsal segments of the forelegs.

CHIRONOMUS (CHIRONOMUS) SETONIS sp. nov.

This species is very common at the seashore, and the type specimens were reared from larvæ found in salt pools at Shirarahama and in rock tide pools at Seto. These pools are usually found near the high-tide mark and the water in them varies

from fresh to saturated salt water in different topographic and climatic conditions.

Male.—Body about 5 mm long, slender, ground color yellow. Head pale brown, including mouth parts and first segments of antennæ; distance between eyes on vertex very small; frontal tubercles minute, antennæ 12-segmented, brown; antennal ratio about 3; maxillary palpi distinctly 4-segmented (3 : 10 : 10 : 15).

Thorax yellow, with a yellow median vitta and two, brownish yellow, lateral vittæ; postscutellum also brownish yellow; supra-alar setal group represented by five dark setæ.

Abdomen yellow, with yellowish white setæ; each tergum from the second to seventh with a brown spot on meson, these spots of the anterior three segments larger than those of the other caudal segments. Hypopygium (Plate 3, fig. 24) pale brown; ultimate tergum brown, with a U-shaped chitinization on meson, setigerous on caudal region; anal point well developed, thickened, curved ventrad; coxites each with four or five slender setæ on its ventromesal edge; styles slender, tapering on the distal half, each with seven stiff setæ on the dorsal side of its tip, about thirteen small setæ on the ventral side of its entire length; dorsal appendages bare, thickly chitinized, strongly curved ventrad, especially thickened on its lateral edges; ventral appendages almost straight, extending just before the middle of the styles and not reaching the tip of the anal point, provided with many strongly curved setæ on tip.

Legs, including coxæ, yellow; distal tip of each tarsal segment slightly brown; proportional lengths of the five tarsal segments of foreleg 82 : 45 : 40 : 35 : 17; leg ratio 1.5 to 1.6; forelegs not bearded, without tibial spurs; middle and hind tibiæ each with two spurs and usual large combs; claws slender, simple; empodium slender, setigerous, extending as far as the tips of the claws; pulvilli large, padlike, as long as the claws themselves.

Wings hyaline; crossvein brown; fCu just beyond r-m; R, R_1, and R_{4+5} brown, setigerous; R_{2+3} closely extended along vein R_1, ending near the tip of R_1. Halteres yellowish brown.

Female.—Body about 4 mm long; coloration generally subequal to that of the male, but different in the paler lateral vittæ of the scutum, yellow halteres, and more obscure dorsal spots of abdominal segments.

Maxillary palpi 4-segmented (2 : 10 : 10 : 17); antennæ pale brown, 6-segmented (4 : 8 : 6 : 7 : 6 : 10); distal segment with an apical seta; intermediate segments each with a distinct neck

region. Hypopygium closely resembling that of the preceding species, *Ch. kiiensis,* only different in the more setigerous sternum and more spinulose octavalvæ; spermathecæ (Plate 2, fig. 20) two, more elongated than in related species, very slightly brown on neck region. Forelegs show the following proportional lengths of tarsal segments: 90:48:43:43:18; leg ratio 1.6 to 1.7; pulvilli far larger than in the male. Other structures of the female closely identical with those of the male.

Pupa.—Body 7 to 8 mm long; exuviæ brown, with lateral chitinizations on the abdominal segments.

Sheaths of frontal tubercles prominent, curved ventrocaudad, each with a simple preapical seta, ended in a sharp point. Prothoracic respiratory organs consisting of numerous white filaments. First abdominal segment not spinulose; other abdominal segments, from second to eighth, more or less spinulose on dorsal side with minute spinules; spinulose area of second to sixth segments broad; that of the seventh small, separated by a median bare area into lateral halves; that of the penultimate segment also paired but broader than that of the preceding segment; marginal ridge of second abdominal tergum consisting of a single row of small chitinized hooklets; these hooklets (Plate 2, fig. 19) sharply pointed; fourth segment with a pair of spinulose blunt tubercles on laterocaudal corners of venter; penultimate segment provided with a pair of large black spines; these spines (Plate 2, figs. 17 and 18) usually double in structure and sometimes single; caudal, finlike, swimming expansions of the ultimate segment large, dark brown, deeply incised at caudomeson; each lateral half of the caudal expansion provided with about sixty-five long swimming hairs and a single isolated seta on its margin. Caudal incision of the swimming expansion larger and deeper in female than in male; genital sheaths of male large, elongate, extending beyond caudal margin of swimming expansion, those of female small, spherical, not extending beyond expansion.

Habitat.—Salt water; Japan.

Holotype.—Male; hypopygium mounted in euparal; Shirarahama, Wakayama Prefecture; June 17, 1930.

Allotopotype.—Female; June 17, 1930.

Paratopotype.—Female; hypopygium mounted in euparal; June 17, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected and reared by M. Tokunaga.

The coloration, the values of the leg ratio and the antennal ratio, and the structures of the hypopygium of the present species are closely related to those of *Chironomus javanus* Johannsen, but the proportional lengths of the third and fourth tarsal segments of the forelegs are distinctly different. Another related species may be *Chironomus quadratus* Johannsen, but it is distinguishable by the different coloration of the thorax.

CHIRONOMUS (CHIRONOMUS) BASITIBIALIS sp. nov.

This species is very common at Seto, Wakayama Prefecture, being frequently captured at light ashore and, in the daytime, often found resting on the walls of the shore caves.

Male.—Body about 5 mm long; ground color yellowish brown.

Head brown, including mouth parts and antennæ; eyes very narrowly separated from each other on the dorsal side; frontal tubercles small; antennæ 12-segmented; antennal ratio about 3.6; maxillary palpi 4-segmented (2 : 9 : 11 : 17).

Thoracic coloration resembling that of *Chironomus kiiensis* Tokunaga; three dorsal vittæ reddish brown; caudal margin of median vitta and cephalic margins of lateral vittæ narrowly dark brown, thus the scutum with six dark stripes; ventral side of mesosternepisternum reddish brown; pleural side with brown patterns near the base of the wing as in *Ch. kiiensis;* supra-alar setal group represented by six small setæ.

Abdominal coloration closely resembling that of *Ch. setonis* Tokunaga, having a more or less brown spot on each tergum from the second to seventh segments. Hypopygium (Plate 3, fig. 25) brown, setigerous; anal point well developed, curved ventrad; coxites each with six setæ on its ventromesal edge; styles slender, tapering on the distal half, each with six stiff setæ on its tip and twelve slender setæ on its ventral side; dorsal appendages large, bare; ventral appendages almost straight, with curved strong setæ on the tip.

Coloration of legs characteristic; coxæ, trochanters, and last tarsal segments of all legs entirely brown, femora and basal halves of fore tibiæ brown, proximal one-half or one-third of each middle and hind femur brown, four proximal tarsal segments brown only on distal ends; other parts of legs yellow; leg ratio about 1.62; proportional lengths of fore tarsal segments 86 : 49 : 42 : 36 : 18. Combs and spurs of middle and hind tibiæ large; spurs and beards of foreleg wanting; empodium slender, setigerous, as long as the claws; pulvilli large, padlike in structure, setigerous, extended hardly as far as the tips of the claws.

Wings hyaline; crossvein slightly brown; fCu under r-m; R, R_1, and R_{4+5} slightly brown, setigerous; R_{2+3} extending closely along R_1, ending just beyond the tip of R_1. Halteres white.

Female.—Body 4 to 4.5 mm long; coloration as in male, but different in the browner abdominal terga and pale brown antennæ.

Head with minute frontal tubercles; antennæ 6-segmented (3 : 8 : 5 : 6 : 5 : 12); ultimate segments usually subequal in length to the preceding two segments taken together, but sometimes reduced in length and showing the ratio 3 : 8 : 6 : 7 : 6 : 11, provided with a small preapical seta and usually without apical setæ; intermediate antennal segments each with a distinct neck region. Usually median vitta of scutum more distinctly separated by a median pale line than in the male. Dorsal side of abdominal segments brown; each tergum with a narrow yellow band on caudal margin; coloration of ultimate segments dark brown. Hypopygium brown, setigerous; ultimate sternum setigerous, with a U-shaped caudal incision; lateral lobe of the octavalva spinose with minute inwardly grown spinules; cerci yellow, somewhat angulate; ventrobasal lobes of the cerci well developed, distinctly angulate; spermathecæ (Plate 2, fig. 21) two, large, oval, and hyaline. Coloration of legs similar to that of the male; usually the proximal part of the fore tibia distinctly darker than in male; sometimes brown femur of foreleg darkened on its distal tip. Other structures of the head, thorax, abdomen, wings, and legs are closely similar to those of the male.

Habitat.—Fresh water (?); Japan.

Holotype.—Male; hypopygium mounted in euparal; Seto, Wakayama Prefecture; August 31, 1930.

Allotopotype.—Female; August 21, 1927.

Paratopotypes.—Females; head and hypopygium mounted in euparal; August 20 and 21, 1927, June 26 and August 31, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species is closely allied to *Chironomus rhyparobius* Kieffer and *Ch. palpalis* Johannsen, but it differs from the former related fly in the values of the leg ratio and the antennal ratio; from the latter species it differs in the shorter distance between the eyes, which is about one-sixth or one-seventh of the head width, and in the slenderer dorsal appendages of the male hypopygium.

CHIRONOMUS (POLYPEDILUM) OCTOGUTTATUS sp. nov.

This species is very commonly found at the Seto Marine Biological Station in summer and often captured at a light screen ashore.

Male.—Body entirely dark brown, about 4.5 mm long.

Distance between the eyes on the dorsal side very short, about one-third of the vertical length of the eyes themselves; antennæ 14-segmented; antennal ratio about 2.5; maxillary palpi distinctly 4-segmented (2 : 5 : 7 : 10); labellum brown; frontoclypeus setigerous with long brown setæ; frontal tubercles wanting.

Thorax without distinct vittæ, with dark median line on the scutum; pronotum very narrow; scutellum yellowish brown, setigerous with many small setæ; postscutellum dark brown.

Abdomen slender, setigerous in general appearance, dark brown on the dorsum; last two sterna dark brown, setigerous; hypopygium (Plate 4, fig. 27) setigerous; ultimate tergum with an oval setigerous thickening on its meson, highly setigerous on its caudal margin; anal point long, distinctly thickened; coxites constricted before the styles; styles setigerous, broad, with small setæ on mesal ridges of distal region; dorsal appendages of hypopygium slender, bare, chitinized, slightly curved, extending caudad beyond tip of anal point; ventral appendages stout, pubescent, straight, slightly swollen on the apex, each with a long straight seta and many strongly curved setæ on distal swollen part.

Legs brown in ground color; coxæ dark brown; femora dark brown; leg ratio 1.5 to 1.6; tibial combs of middle and hind legs consisting of two basally fused spinules which occupy about two-thirds of the circumference of the tibial tip; small comb with a small spur and large comb without trace of spur; claws simple; empodium slender, setigerous, as long as the claws themselves; pulvilli large, padlike, setigerous, as long as empodium.

Wings (Plate 4, fig. 26) hyaline, with eight nebulose dark patterns; three dark nebulæ in cell R_5, two in cell M_2, one in M_4, one between veins 1A and 2A; veins R, R_1, and R_{4+5} setigerous, brown; r-m short, brown; R_{2+3} ending slightly beyond end of R_1; fCu beyond the crossvein. Haltere yellow.

Female.—Body 2.5 to 3 mm long; coloration similar to that of the male. Antennæ 6-segmented (3 : 6 : 4 : 5 : 5 : 8); ultimate segment dark brown, with two long apical setæ; intermediate segments each with a short but distinct neck region; maxillary palpi 4-segmented (3 : 5 : 7 : 12); ultimate segment

comparatively longer than in male. Wing pattern similar to that of male, but sometimes an additional nebula located in the distomarginal area of cell M_2, in such a case cell M_2 with three nebulæ. Hypopygium (Plate 4, fig. 28) especially dark brown, setigerous; ultimate sternum broad, with a large U-shaped incision on its caudomesal margin; cerci short, angulate, rhombic; octavalvæ bilobate into a large, broad, median lobe and a slender, fingerlike, lateral lobe, as shown in fig. 28; spermathecæ two, hyaline, spherical. Other structures of the head, thorax, abdomen, wings, and legs closely resemble those of the opposite sex.

Habitat.—Fresh water (?); Japan.

Holotype.—Male; Seto, Wakayama Prefecture; June 21, 1930.

Allotopotype.—Female; June 21, 1930.

Paratopotypes.—Females; hypopygium mounted in euparal; June 21, 1930.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species closely resembles *Chironomus* (*Polypedilum*) *emarginatus* Kieffer and *Ch.* (*P.*) *nubiculosus* Meigen, but is distinctly different in the possession of many nebulæ on the wings and pale halteres and also distinguishable by the different values of the leg ratio and the antennal ratio.

ILLUSTRATIONS

PLATE 1

FIGS. 1 to 12. *Chironomus* (*Chironomus*) *enteromorphæ* sp. nov.; *1*, male hypopygium, dorsal aspect, with dorsal appendage; *2* to *5*, pupal spines of penultimate segment, showing variation; *6*, pupal abdomen from second to seventh segments, dorsal aspect; *7*, hooklike spine of caudal comblike edge of second abdominal segment of pupa; *8*, various dorsal spinules of pupal abdomen; *9*, pupal spinulose patch of fourth abdominal sternum; *10*, various hooklets of posterior pseudopod of larva; *11*, various hooklets of anterior pseudopod of larva; *12*, larval maxilla, ventral aspect.

PLATE 2

FIGS. 13 to 16. *Chironomus* (*Chironomus*) *enteromorphæ* sp. nov.; *13*, larval mentum, ventral aspect; *14*, larval hypopharynx, dorsal aspect; *15*, larval labroepigusta, cephalic aspect; *16*, larval premandible, lateral aspect.

17 to 20. *Chironomus* (*Chironomus*) *setonis* sp. nov.; *17* and *18*, pupal spines of penultimate segment, showing variation; *19*, pupal hooklike spine of caudal comblike edge of second abdominal segment; *20*, female spermatheca.

FIG. 21. *Chironomus* (*Chironomus*) *basitibialis* sp. nov.; female spermatheca.

PLATE 3

FIG. 22. *Chironomus* (*Chironomus*) *enteromorphæ* var. *pacificus* var. nov., male hypopygium, dorsal aspect.

23. *Chironomus* (*Chironomus*) *kiiensis* sp. nov., male hypopygium, dorsal aspect.

24. *Chironomus* (*Chironomus*) *setonis* sp. nov., male hypopygium, dorsal aspect.

25. *Chironomus* (*Chironomus*) *basitibialis* sp. nov., male hypopygium, dorsal aspect.

PLATE 4

FIGS. 26 to 28. *Chironomus* (*Polypedilum*) *octoguttatus* sp. nov.; *26*, male wing; *27*, male hypopygium, dorsal aspect; *28*, female ultimate sternum, with spermathecæ and valval lobes, ventral aspect.

FIG. 29. *Chironomus* (*Chironomus*) *kiiensis* sp. nov., female ultimate sternum, with spermathecæ and valval lobes, ventral aspect.

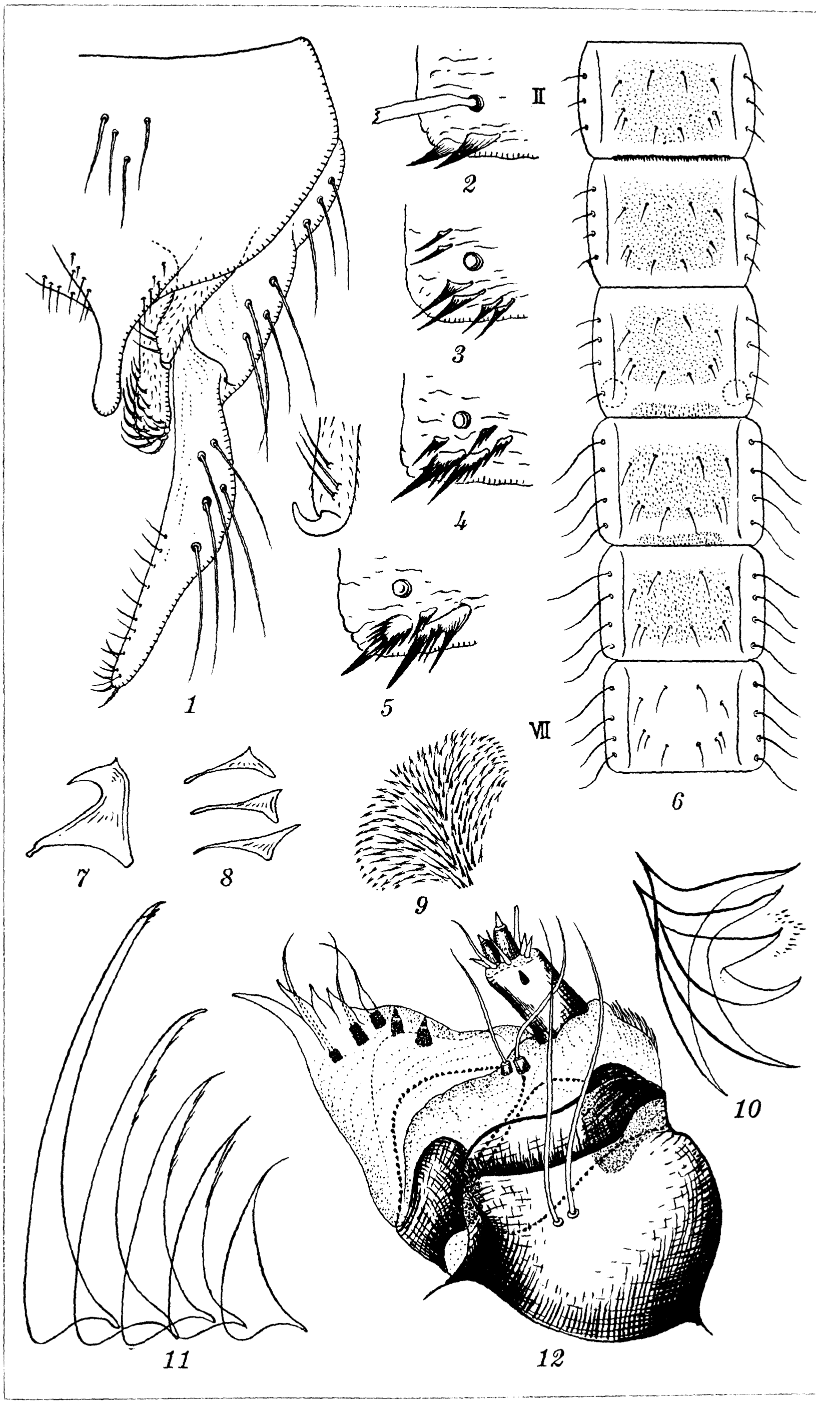
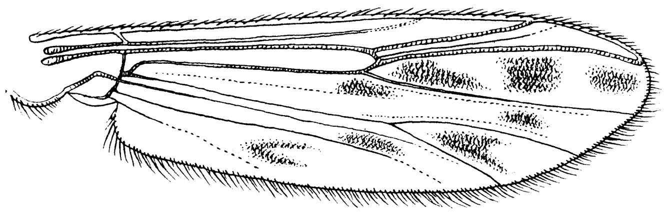
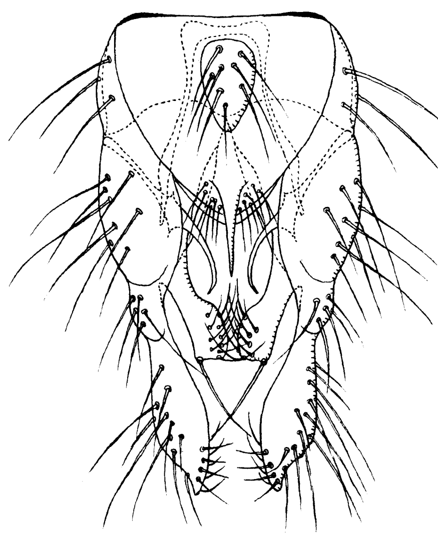


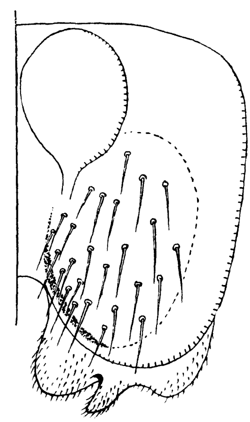
PLATE 1.



26



27



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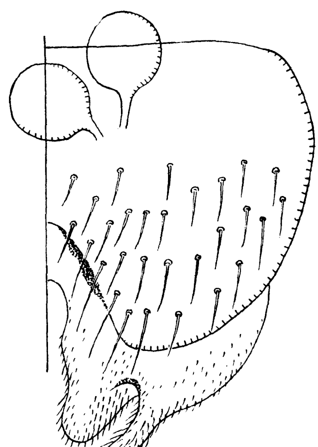

28

PLATE 2.

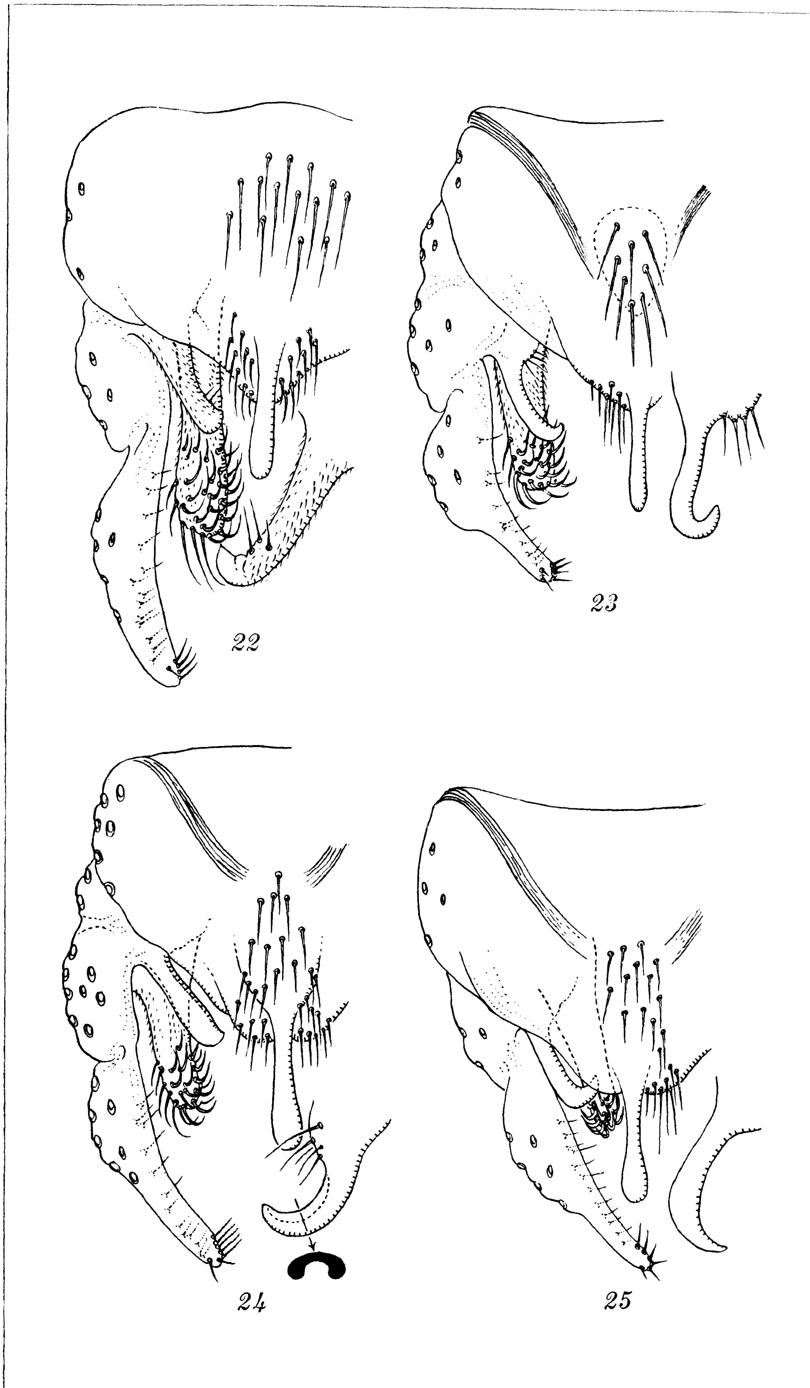

PLATE 3.

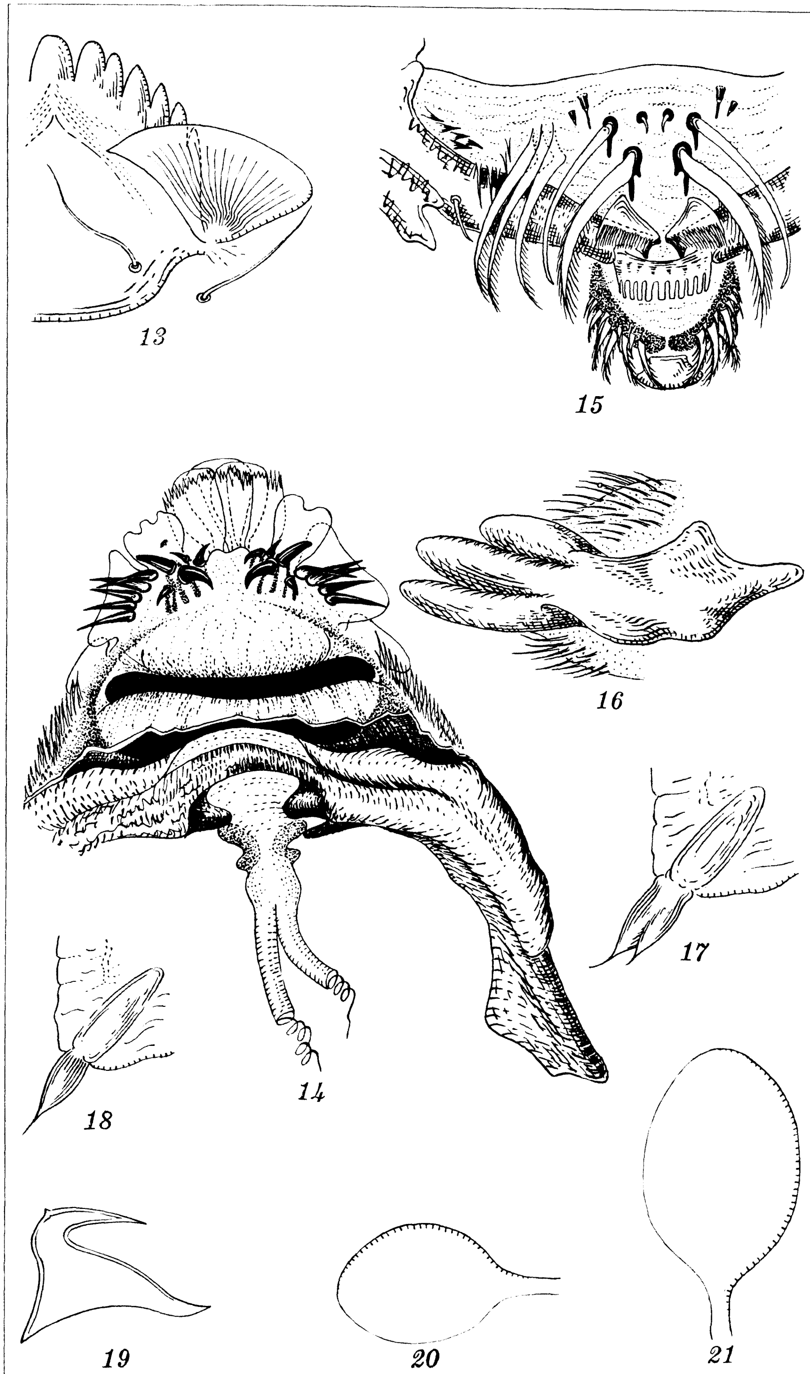

PLATE 4.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

BROWN, SANGER, and HOWARD W. POTTER. The psychiatric study of problem children. Utica, N. Y., State hospitals press, 1930. 152 pp.

Central coöperative anti-malaria society. Annual report. Calcutta, 15th, 1935. 59 pp.

DAVIDOFF, LEO M. Brain tumors; their pathology, symptomatology, diagnosis and prognosis. Utica, N. Y., State hospitals press, 1931. 158 pp.

FERNANDEZ, JOSÉ M. M. Impresiones acerca del estado de la lepra en Estados Unidos de Norte America, Hawaii, Filipinas, Japon, India y Brasil. Rosario, Editorial medica Lagos, 1935. 173 pp.

FORTUNE, R. F. Manus religion; an ethnological study of the Manus natives of the Admiralty Islands. Philadelphia, American philosophical society, 1935. 391 pp.

HUTCHINS, RICHARD HENRY. A psychiatric word book, a lexicon of terms employed in psychiatry and psychoanalysis designed for students of medicine and nursing and psychiatric social workers. 4th ed. Utica, N. Y., State hospitals press, 1935. 212 pp.

KÜHN, B. C. R. Die bergbaukunst nach dem vortrag. [n.d.] 3 pts.

LIDDELL, DONALD M., and GILBERT E. DOAN. The principles of metallurgy. New York and London, McGraw-Hill book co., 1933. 626 pp.

LUNDHOLM, HELGE. Conation and our conscious life; prolegomena to a doctrine of urge psychology. Durham, N. C., Duke university press, 1934. 95 pp.

MALZBERG, BENJAMIN. Mortality among patients with mental disease. Utica, N. Y., State hospitals press, 1934. 234 pp.

Onchocerciasis with special reference to the central American form of the disease. Cambridge, Harvard university press, 1934. 234 pp.

Pacific science congress, 5th, Victoria and Vancouver, Canada, 1933. Proceedings of the fifth Pacific science congress, held under the auspices of the National research council of Canada. Canada, University of Toronto press, 1933. 5v.

PASCHER, A. Die süsswasserflora mitteleuropas, bearb. von prof. dr. G. Bech Mannagetta, J. Brunthaler, dr. V. Czurda, herausgegeben von prof. dr. A. Pascher. 2. aufl. Jena, G. Fischer, 1913–1932. 7 v.

PINTO, CESAR. Profilaxia das doeças infecciosas e parasitarias dos animais domesticos do Brasil. Rio de Janeiro, Ministerio da agricultura, Brasil, 1933.

RAMAN KUTTY MENON, S. The coconut industry of Travancore. Quilon, S. R. V. press, 1933. 189 pp.

REID, WILLIAM DUNCAN. Teaching methods in medicine; the application of the philosophy of contemporary education to medical schools. Newton, Mass., The Graphic press. 11 pp.

Texas. University. Bureau of research in the social sciences. Study. no. 3. 1931.

VECHT, JACOBUS VAN DER. De groote peperwants of semoenjoeng (Dasynus piperis China). Leiden, N. V. Boek-en steendrukkerij, E. Ijdo, 1933. (Proefschrift Ph. D., Leiden. Rijksuniversiteit, 1933.) 95 pp.

WEBER, GUSTAVUS ADOLPHUS. The Bureau of entomology; its history, activities and organization. Washington, The Brookings institutions, 1930. 177 pp.

WILE, FREDERIC WILLIAM. Emile Berliner; maker of the microphone. Indianapolis, Bobbs-Merrill co., 1926. 353 pp.

MARCH 9, 1936

American bureau of metal statistics. Year book. N. Y., 5th, 1934, 112 pp. tables. Price, $2.

American society for testing materials. Committee A–5 on corrosion of iron and steel. Report. Philadelphia, Pa., 1935. 31 pp. fold. tables. Price, $0.50.

American society for testing materials. Committee D–2 on petroleum products and lubricants. A. S. T. M. standards on petroleum products and lubricants. Philadelphia, Pa., 1935. 358 pp. illus., tables, diagrs. Price, $1.75.

American society for testing materials. Committee D–11 on rubber products. A. S. T. M. standards on rubber products. Philadelphia, Pa., 1935. 204 pp. illus., tables, diagrs.

American society for testing materials. Committee D–14 on screen wire cloth. Report. Philadelphia, Pa., 1935. 20 pp. illus., tables, diagrs. Price, $0.35.

BARD, LILIAN. Daily what to "eats"; is a book of master menus with recipes easily found and followed. It's purpose—meal time made easy, dedicated to ladies of America distributed through their associations and organizations. Lancaster, Pa., The Author. [c. 1933.] 48 pp. port.

BRETT, T. J. Engineer-custodians manual; examination questions and answers for engineers, custodians, firemen, building superintendent, etc., including boilers and combustion, engines, heating and ventilating, air conditioning, pumps, sanitation and plumbing, electrical machinery, mechanics, technical formulas, tables, and general information. Chicago, American technical society, 1934. 184 pp. Price, $2.50.

Canning, W., & co., pub. The Canning practical handbook on electroplating, polishing, bronzing, lacquering and enamelling. 12th ed. Birmingham, London & Sheffield, W. Canning & co., 1934. 344 pp. front., illus., tables, diagrs. Price, $2.

Carnegie institution of Washington. Elihu Root lectures of Carnegie institution of Washington on the influence of science and research on current thought. Washington, 1935. v+54 pp.

CORBET, ALEXANDER STEVEN. Biological processes in tropical soils with special reference to Malaysia. Cambridge, W. Heffer & sons, [1935] xiv+156 pp., front., tables, diagrs., plates. Price, $2.

DEGLER, HOWARD EDWARD. Diesel and other internal-combustion engines; a practical text on the development, principles of operation, construction, details and performance of stationary and portable diesel, gas, and gasoline engines. Chicago, American technical society, 1936. 237 pp. front., illus., tables, diagrs. Price, $2.50.

DYKE, ANDREW LEE. Dyke's automobile and gasoline engine encyclopedia; the elementary principles, construction, operation and repair of automobiles, gasoline engines and automobile electric systems; including trucks, tractors, motor-coaches and motorcycles; simple, thorough and practical. 7th. ed. Chicago, The Goodheart-Willcox co., 1935. xxxvi +1249 pp. illus. tables. Price, $6.

Edwenil; a lysinogenic agent for the control of endotoxic infections. Walford, England, R. Samuel & co., [n. d.] 12 pp. diagrs.

FITZPATRICK, FREDERICK LINDER. Biology for public school administrators. N. Y. City, Teachers college, Columbia university, 1934. vi+ 87 pp. Price, $1.25.

Fundamentals of dairy science, by associates of Lore A. Rogers. 2d ed. N. Y., Reinhold publishing corp., 1935. 616 pp. front., illus., tables, diagrs. Price, $6.

GERSHENFELD, LOUIS. The Jew in science. Philadelphia, Pa., The Jewish publication society of America [c. 1934]. vii+224 pp. Price, $2.75.

HORN, PAUL VALENTINE. International trade principles and practices. N. Y., Prentice-Hall, 1935. xxiv+723 pp. tables, diagrs., forms. Price, $5.

HYLANDER, CLARENCE JOHN. American scientists. N. Y., Macmillan, 1935. xiii+186 pp. front., ports. Price, $2.

International veterinary congress, N. Y. International veterinary congress. 1934. 12th, 3 v. illus., tables, diagrs.

KNAPP-FISHER, HUBERT CLINTON. The world of nature, with an introduction by E. W. MacBride and illustrations of more than 500 forms of life by Joan Harrison. London, V. Gollancz, 1935. 512 pp. illus. Price, $1.50.

KOFOID, CHARLES A. Termites and termite control. [ed. by] Charles A. Kofoid, S. F. Light, A. C. Horner, and others. 2d ed. rev. Berkeley, University of California press., 1934. xxvii+795 pp. front., illus., diagrs., tables. Price, $5.

Liverpool biological society. Proceedings and transactions. University press of Liverpool, 1935. vol. 84, xi+98 pp. tables, diagrs. Price, $5.25.

The Mineral inquiry. Elements of a national mineral policy; prepared by the Mineral inquiry. Charles K. Leith, H. Forter Bain, S. M. Marshall. N. Y., 1933. vi+162 pp. tables, diagrs.

National research council. Division of anthropology and psychology. Committee on child development. Research in child development. 53 pp. appendix.

The Research association of British rubber manufacturers, Groydon, England. Library catalogue. Cambridge, W. Heffer & Sons, 1927. 210 pp.

RIESBECK, ERNEST WILLIAM. Air conditioning; fundamental principles, practical installations and Ozone facts. Chicago, The Goodheart-Willcox co., 1934. 352 pp. illus., tables. Price, $3.50.

Society for research in child development, Washington, D. C. Proceedings, 1st biennial meeting, 1934. ix+99 pp.

TOWNSEND, GILBERT. Carpentry; a practical treatise on simple building construction, including farming, roof construction, general carpentry work, exterior and interior finish of buildings, building forms and working drawings. Chicago, American technical society, 1936. 436 pp. illus. Price, $2.

WILLIAMS, JESSE FEIRING. Atlas of human anatomy, with explanatory text. Colored illustrations by Franz Frohse, Max Brôdel [and] Leon Schlossberg. N. Y., Barnes & Noble [c. 1935]. 64 pp. col. illus. Price, $2.

REVIEWS

Atlas of Human Anatomy. By Jesse F. Williams. Barnes & Noble Inc., New York, 1935. 64 pp. illus. Price, $2.

The new Atlas of Human Anatomy by J. F. Williams is undoubtedly intended to furnish the layman with a brief but sufficiently comprehensive compendium of human anatomy. As an atlas for quick reference and as a refresher, the book extends its field of utility to students of human biology and to medical men as well. A perusal of the work will convince anyone of its special merits—compactness, accuracy, and magnificence in illustrations.

The usefulness of an atlas of human anatomy is so well recognized that such standard works as those of Spalteholzs and Basker, and Sobotta and Toldt, have long become the friends of students in dissection. Only their relatively high cost has prevented a more general adoption, to the regret of those teaching the subject. We welcome this particular atlas, because with the additional advantage of reasonable cost it will prove, in our opinion, one of the most popular books with medical students in their course in dissection.—M. L.

Organic Solvents; Physical Constants and Methods of Purification. By A. Weissberger and E. Proskauer. Translated from the German manuscript by R. G. A. New. The Clarendon Press, Oxford, 1935. 212 pp. Price, $5.

In this publication the authors have endeavored to collect the recent literature on the physical constants and methods of purification of a number of organic solvents.

The first part of this text contains a systematic classification of organic solvents. The second part has tables of physical constants of organic solvents and in this respect resembles a handbook. The third part gives methods for purifying solvents

and appropriate tests for purity. Particular attention is paid to the characteristic impurities that are usually found in individual solvents, and special methods are suggested for removing them.

For the compounds and data recorded in each part of the book there are numerous literature references. These are very desirable as, at times, it is advisable to consult the original literature. For work requiring the use of various classes of organic solvents this text should be very helpful.—A. P. W.

Fundamentals of Dairy Science. By associates of Lore A. Rogers. (American chemical society. Monograph series No. 41.) Reinhold Publishing Corporation, New York, 2d ed., 1935. 616 pp. Price, $6.

This book is a compilation of reports made by specialists along various lines of the dairy industry. It gives a good review of the modern literature on dairy science and of the recent researches in this field, together with an extensive bibliography.

Subjects such as the composition, physical chemistry, microbiology, and nutritional value of milk and milk products are discussed quite fully. Good accounts are also given of topics such as yeasts, molds, bacteria, and the physiology of milk secretion.

As a text and reference book in dairy science it should be useful for chemists and also for advanced students specializing in this line.—A. J. H.

1000 Questions and Answers on T. B. Edited by Fred H. Heise. Journal of the Outdoor Life, New York City, 1935. 232 pp. Price, $0.75.

This book is admirably designed to furnish a lay, educated public with frank information on all the aspects of tuberculosis that are likely to be uppermost in the minds of such a public, from heredity and predisposition to symptoms, complications, immunity, and methods of treatment. In his explanations and definitions throughout, the author has happily made a reality of that facility so difficult to attain when vulgarizing science. Buoyant simplicity characterizes the whole book, making it easy and pleasant to read. By means of questions and answers disposed in easy, fitting succession, the author takes the reader along, wisely sounding a word of warning when the question rings very optimistic, rather reserved when the question smacks of erudition, and relieving, soothing, quieting, and comforting when the question bespeaks anxiety. Yet the book is characterized throughout by courageous frankness and straightforwardness.—A. V. C.

Biological Processes in Tropical Soils. By A. S. Corbet. W. Heffer and Sons Ltd., Cambridge, London, 1935. 156 pp. 7s. 6d.

This book contains very interesting and valuable data on biological processes as concerned with tropical conditions. The geographic and climatic conditions with special reference to soil origin and soil formation of the Malay Archipelago are well discussed. Throughout the book the author lays special emphasis on the effect of the climatic factor on plant life and on microbiologic activities in the soil. The subject of soil organic matter is well presented. The nitrogen cycle is discussed thoroughly, showing the important steps of chemical reactions concerned.

Jenny's Law, which is concerned with the accumulation of nitrogen in the soil as affected by temperature and humidity, is discussed clearly.

The book is a source of valuable information for students of soil biology and soil chemistry. In the appendix are standard methods for soil examination. The physical, chemical, and biological analyses are briefly discussed.—M. M. A.

Automobile and Gasoline Engine Encyclopedia. By Andrew L. Dyke. The Goodheart-Willcox Co., Chicago, 7th ed., 1935. 1,240 pp. illus. Price, $6.

A complete automotive library in one volume, this book on American practice in automobile engineering and repairing gives special instructions on locating troubles, testing, and adjusting parts. It includes private, commercial, and tractor types with specifications, and thousands of diagrams, charts, and illustrations.

The book contains over 1,000 pages covering all classes of automobile information; over 4,000 pictures, plans, diagrams, and charts; a complete index of 79 pages; one section devoted to locating trouble on cars; special instructions on testing and adjusting every part of the automobile; specifications for gasoline passenger cars, trucks, and tractors; specifications for replacements, accessories, interchangeable parts, and equipment; charts showing working principles of the automobile, trucks, and tractors. This is an indispensable book for automotive engineers, auto mechanics, and machine shops.—R. M.

Acidosis and the Dietetic Treatment of Diseases. By Basanti C. Sinha. The Swasthya Sangha, Calcutta, 1935. 15 pp.

In this little pamphlet the origin of acidosis and the part which this condition plays in disease is discussed very briefly. According to the author, who is apparently not a medical man, many diseases, such as cholera, dysentery, diabetes, etc., "are

cured not by treating the cases with drugs suitable for the diseases, but by treating them as of acidosis only." Great reliance is placed on the successful treatment of acidosis by proper dieting. For this reason a short list of acid and alkaline foodstuffs is given.—M. B.

A. S. T. M. Standards on Petroleum Products and Lubricants. Prepared by Committee D-2 on Petroleum Products and Lubricants. American Society for Testing Materials, Philadelphia, Pa., 1935. 358 pp. Price, $1.75.

The current edition, 1935, of Committee D-2 on Petroleum Products and Lubricants, includes all A. S. T. M. standards pertaining to petroleum in one volume of 358 pages. It contains 57 test methods, six specifications, and two lists of standardized definitions of terms, all of this material being given in its latest approved form.

The current report of Committee D-2 comprises an interesting discussion of the work on the Sligh oxidation test with a proposed method of test for oxidation number of lubricating oils and gives the revised Diesel fuel-oil classification which is published for information.

A new method of test given for the first time covers the vapor pressure of motor and aviation gasoline (Reid method).

—F. D. R.

Chemistry and Technology of Wines and Liquors. By K. M. Hersrein and T. C. Gregory. D. Van Nostrand Company, New York, 1935. 360 pp. Price, $5.50.

This book gives modern methods of manufacturing various kinds of wines and beverages and their analyses. Various essentials of the alcoholic beverage industry, such as sugars, starches, enzymes, fermentation, yeasts, and malt, are discussed from both the theoretical and practical points of view. Many formulæ for the manufacture of liquors and cordials are given.

The book will be very useful for chemists and students specializing in the fermentation industries in particular and as a reference text in industrial chemistry in general.—F. A.

The Jew in Science. By Louis Gershenfeld. Jewish Publication Society of America, Philadelphia, Pa., 1934. 224 pp. Price, $2.75.

Persecuted in every land in which he sought to earn his living, denied the right to worship the God that his persecutors adopted for their own, downtrodden and despised, discriminated against and suffering untold mental and physical agonies, the Jew still made possible the discovery of the New World by

Columbus who also was half Jew. Quoting Prof. Herbert B. Adams, of Johns Hopkins, "Not jewels but Jews were the financial basis for the first expedition of Columbus."

The discovery of America was made possible because of the personal efforts and fortunes of Jews high in governmental positions. Columbus guided his ships across unknown seas by means of nautical instruments and astronomical tables invented and compiled by the Jews Abraham Zacuto, Levi ben Gerson, and Jacob ben Makir. His vessel in part was manned by Jewish sailors. That is history. Yet in the same year that a new empire was founded for her, Spain expelled the Jews from her soil!

The Jew was rigidly prohibited from attending European Universities and from engaging in any form of scientific endeavor as late as the middle of the nineteenth century. Though the flame of Jewish scholarship was for centuries not permitted to rise to a bright light, it nevertheless was not suffered to grow cold. It smouldered in every Jewish home, rising to its natural brilliance only when the Inquisition and political discrimination were withdrawn.

The Jews' contribution to the world's fund of knowledge, all through the ages, has been vast. It was accomplished without solicitation or encouragement on the part of the millions who benefited by it. It was done in spite of insurmountable handicaps and penalties. The Jews' objective was not mere personal reward, but service to man.

It is astounding how persistent the urge to heal has remained with the Jew. It antedates Christ by many thousands of years. How much more wretched and unhappy the world would be to-day without the epochal discoveries of the Jew Paul Ehrlich. What affliction and misery were imposed upon the hapless victims of syphilis until salvarsan was invented by this indefatigable Jew!

In the field of mental diseases an equally important contribution to the world was made by the pioneer psychiatrist Sigmund Freud. No less was the contribution made by Lombroso. If space permitted, hundreds of other Jewish names could be enumerated.

Other fields of science have been equally enriched by the fertile Jewish brain. A few sample names will suffice: Heinrich P. Hertz, Vladimir Michelson, the Herschels, and Einstein.

Political philosophy and economics have equally profited from such Jewish scholars as Gustave Cassel, Ignatz Jastrow, Harold J. Lasky, E. R. A. Seligmann, and Karl Marx.

The Jew has ever remained an enigma to a wondering world. Adversity has developed in him a deep sense of humanitarianism; a desire to relieve human suffering by means of both medical service and philanthropy. Adversity has not deadened but sharpened his active mind. With the advent of greater political, civic, and economic opportunities, the Jew will play an even more important rôle in science than in the past.—L. L.

Stars and Telescopes. By James Stokley. Harpers and Brothers, New York, 1936. 319 pp. Price, $3.

The author in his foreword states that the purpose of the book is to acquaint the ordinary visitor to a planetarium or observatory with the fundamentals of astronomy. This he has accomplished to a marked degree, stripping the subject of its classroom aspect without sacrificing truth or clarity. The book will satisfy the desire of the casual inquirer to know something about the heavens, and, at the same time, awaken and stimulate the interest of the more inquiring mind in the doctrines herein stated briefly. The chapters dealing with the history of astronomy and life in the universe are particularly well done. It is pleasing to find that the author knows how to distinguish between facts and theories, and takes a conservative view of the latter.—E. J. N.

The Application of Absorption Spectra to the Study of Vitamins and Hormones. By R. A. Morton. Adam Hilger, Ltd., London, 1935. 70 pp. Price, 10s.

This book contains a literature review on the application of absorption spectra to the study of vitamins and hormones.

The difficulty in getting pure materials naturally affects the accuracy of absorption-spectra studies. However, these data, which are largely empirical, serve as a supplement to the results of biochemical and organic methods of research.

The results obtained for the vitamins A, B_1, B_2, C, D, and the hormones have been compiled for this publication.—A. J. H.

The Rheumatic Diseases: Their Recognition and Treatment. By Francis Bach. Cassel & Co., Ltd., London, 1935. 436 pp. Price, $3.25.

The author emphasizes, first, the importance of appreciating the presence of certain, definite varieties of rheumatic diseases;

second, the need of knowing the natural history of each of them, laying special stress on their clinical recognition, including the value of bacteriological, pathological, and radiological findings; and third, the necessity of applying the well-known methods of treatment while being fully aware of their merits and limitations.

The first part of the book deals with the definition of rheumatic diseases, including anatomy, physiology, and pathology, and a chapter on the general investigation of the individual patient. The second part deals with the different rheumatic diseases, including their diagnosis, differential diagnosis, and treatment. The third part treats mainly of the different methods of therapy.

The book is worthy to be read by every medical practitioner.

—L. G.

The World of Nature. By H. C. Knapp-Fisher. V. Gollancz, Ltd., London, 1935. 512 pp. Price, 6s.

This book is a text on general biology intended for the layman. The author has made a bold effort to discard technical terms and to describe plants and animals in ordinary English. While an expert in one branch of biology may discover occasional inaccuracies in some parts, the value of the book as a whole with its broad outlook is in no way affected. The text is divided into four parts; namely, the seashore; an outline of the plant world; a simple survey of insect life; and fish, flesh, and fowl. The text should make a very interesting and useful reference book for students taking high-school biology, and for teachers of animal and plant life in the grades and in the normal school. Although the forms of life described are mostly English, the book is useful because of its methods of presentation.—H. A. R.

Small-fruit Culture. By James S. Shoemaker. P. Blakiston's Son & Co., Inc., Philadelphia, 1934. 434 pp. Price, $3.50.

The author of this well-produced and generously illustrated book points out in his preface that much of the information given therein embodies the results of experiments and researches under different field conditions. Although considerable information in regard to the culture of small garden fruits has been written, much has not found its way into print for the guidance of the small fruit grower. The author has performed a valuable work by bringing together the scattered data in a comprehensive volume, which will serve as a valuable guide for growers of

small or garden fruits; such as, grapes, strawberries, bramble-fruits, currants, gooseberries, blueberries, and cranberries.

Part I covers grape culture and deals with the general characteristics of the commercially grown grape varieties in Europe and in the United States, the modes of propagation, the soil and climatic requirements, and the planting and culture as practiced in various parts of the United States. In part II the author describes the development of the strawberry industry in the United States, and classifies the regions and strawberry districts as early, second-early, intermediate, and late crops. Bramble-fruit, currant gooseberry, blueberry, and cranberry cultures are dealt with in the remaining chapters. Although they are not cultivated in the Philippines, some of these crops have possibilities in certain regions of the Philippines, such as the Mountain Province and the highlands of Mindanao.—F. G. G.

New World of Chemistry. By Bernard Jaffe. Silver, Burdett & Co., New York, 1935. 596 pp. Price, $1.80.

This book gives a popular and very interesting account of elementary chemistry. Fundamental theories and the characteristic properties of the common elements and compounds are explained briefly and clearly. The historical comments concerning original investigators lend a personal touch that is inspiring to beginners. The many illustrations showing modern methods for producing commercial products are unusually good and depict the practical importance of chemistry. Information on timely topics, such as the stratosphere, Neon lights, stainless steel, shatterproof glass, vitamins, hormones, rayon, and cellophane, makes the book decidedly up-to-date. The teaching aids at the end of each chapter give the book decided advantage over similar textbooks on the subject.—A. P. W.

Chemotherapia del Cancro. By G. Fichera. Ulrico Hoepli, Milano, 1935. Paper, 213 pp. Price, 25 lire.

The author reviews the work of others in the treatment of cancer by the administration of lead in various ways, of other metals such as gold, and of dyes such as methylene blue and other vital stains, which he discusses from various angles.

Arsenic as advocated by the Frankfurt school was found to be well tolerated by the organism, but salvarsan was less so. Selenium appeared to be satisfactory. The author used other chemicals with the addition of amino acids. Sulphur and sulphur casein gave variable results. Copper was fair, especially

in the cutaneous forms of the disease. Lead is claimed to have reduced the mortality from cancer by as much as 25 per cent. It was used alone or in combination with X-ray application.

The author describes the findings of others with respect to hyper- and hyponutrition of tissues in connection with vitamins and hormones. He believes that biologic therapy exerts a definite influence upon the growth of tumors, and discusses extensively the action of the endocrine glands, such as the posterior lobe of the pituitary (Theelin), on the growth of tumors, as to which the opinion of observers is divided. In general the author is optimistic as to the future of chemotherapy in cancer.

The tables accompanying the monograph show the number and sex of patients treated, the types and locations of tumors, and the metals used in treatment, either singly or in combination, but most generally the former. There is a bibliography of more than 600 titles.—C. R.

The Rôle of Environment in the Life of Birds. By Samuel C. Kendeigh. The Duke University Press, Durham, N. C., 1934. (Ecological Monographs, v. 4, No. 3, pp. 299–417.) Price, $1.50.

In this dissertation Doctor Kendeigh certainly presents much food for thought covering the broad field of ecology. The article should be read carefully by naturalists in general and by field ornithologists in particular. Temperature, relative humidity, solar radiation, food, precipitation and wind, biotic interaction and competition, and physiographic features are discussed together with their effects on the behavior, distribution, migration, and abundance of birds. The discussions are supported by results of the author's experiments and observations, correlated with those of over 200 published titles. English sparrows and eastern house wrens were used largely in the study. Although the results will be best applied to temperate species, they involved important biological principles that are of great significance to naturalists everywhere.—C. G. M.

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VOL. 60 JUNE, 1936 No. 2

SOLOMON ISLAND FERNS

By E. B. COPELAND
Of the University of California, Berkeley

TWENTY-THREE PLATES

The Pteriodophytes collected in the Solomon Islands by Messrs. S. F. Kajewski and L. J. Brass, on several expeditions, supported by the Arnold Arboretum and directed by the Brisbane Botanic Gardens, were sent to me for identification in 1933. It was the plan of the arboretum to publish a comprehensive report on the collections of all kinds, and my report on this group was sent there; but the plan is so indefinitely postponed that I can now publish independently. The types of the new species, except *Dryopteris odontophora*, are in the Philippine National Herbarium.

The exploration of the Solomon Islands is necessary for an understanding of the colonization of Polynesia by ferns of ultimately Malay origin. The collections here described show how important is the place of the Solomons as a path of this colonization. We still know this flora too incompletely to justify any extended argument, but the connections with Papua and with Fiji which appear now for the first time are interesting and instructive. It appears already, also, that the Austral element is decidedly less in evidence here than in New Caledonia, or probably than even in the New Hebrides.

TMESIPTERIS OBLANCEOLATA Copel. sp. nov. Plate 1.

Caule 15–20 cm alta, parte tertia inferiore bracteata, sursum dense foliosa; foliis sterilibus 15–20 mm longis, 3 mm latis, oblanceolatis, apice rotundatis oblique et unilateraliter mucronatis,

costa alibi mediale; foliarum fertilium ramis minoribus, aliter conformibus; capsulis 3–4 mm longis, superficie sub lente reticulata.

GUADALCANAR, Tutuve Mountain, altitude 1,700 meters, *Kajewski 2632*. "A very small plant growing out of the moss on the stunted trees at high altitudes. Spore case brown, large."

I have noted elsewhere,[1] that with very many New Caledonia specimens in hand I could not find any correlation between the details of stem structure and other peculiarities. It must also be recognized as a fact that, while a few specimens may seem to represent species quite distinct in form and arrangement of leaves, these distinctions tend to be elided when many specimens are compared. Even so, a sufficient measure of distinctness in these respects should identify a species; and this seems to be provided by the broader distal halves of the leaves, the broadly rounded apices, and the almost symmetrical proximal halves of the leaves.

LYCOPODIUM FILICAULON Copel. sp. nov. Plate 2.

Phlegmaria; speciminibus ultra 1 m longis, fere simplicibus; ramis foliis inclusis ca. 25 mm latis, flaccidis, perlaxis; caule propia 0.6 mm crassa, internodiis vulgo 6 mm longis; foliis trifariis, plerisque ca. 20 mm longis, basin subsessilem versus 2–2.5 mm latis, deinde ad apicem acuminatam planam angustatis, rectis, integris, tenuibus; spicis vix 10 cm longis, 1.5 mm crassis, ad basin furcatis; sporophyllis e basi lata acuminatis, sporangia paullo superantibus sed haud tegentibus.

KONIGURU, Buin, Lake Luralu, altitude 1,500 meters, *Kajewski 2069*. "Common, in rain forest. A very long lycopod, hanging down from the trees sometimes, for a length of 2 meters. . . . Very graceful and slender, making this plant one of delicate beauty." BOUGAINVILLE, Kupei Gold Field, altitude 1,000 meters, *Kajewski 1702;* somewhat less long and lax, but easily the same species.

LYCOPODIUM LONGUM Copel. sp. nov. Plate 3.

Specimene basi carente ultra 1 m longo, pendente, repetiter dichotomo, ramis inter furcas 20 cm longis, basin versus foliis inclusis 3 cm latis, caule propria deorsum 1–1.5 mm crassa, foliis alternatim quadrifariis, confertis, maximis 17 mm longis, 2 mm latis, basi abrupte angustatis, integris, marginibus apices acuminatas versus subreflexis, herbaceis vel subrigidis, infra spicas abrupte diminutis; spicis ca. 15 cm longis, 5–7 mm crassis, ple-

[1] Univ. Calif. Publ. Bot. 14 (1929) 369.

risque 2 cm supra basin furcatis, sporophyllis 5 mm longis, supra basin sporangia protegentibus 1.7 mm latis, deinde angustatis, inflexis.

KUMUGARU, Buin, altitude 150 meters, *Kajewski 1953.* "Native name, *me-tarki.* A *Lycopodium* up to 2 meters long, hanging down from rain-forest trees." A relative of *L. pinifolium,* from which it differs most conspicuously by the inflexed sporophylls. The spikes are similar to those of the Philippine *L. Whitfordii,* from which and from *L. squarrosum* it is distinguished by the very slender axes and weaker leaves.

ANGIOPTERIS MICROURA Copel. sp. nov. Plate 4.

Stipite rhachique pilis brunneis 1 cm longis crinitis intricatis vestitis; pinnula fertile breviter (1.5 mm) stipitulata, ca. 12 cm longa, 12 mm lata, basi subsymmetrice truncato-cordata, marginibus parallelis crenulatis, apice abrupte in caudam 6–10 mm longam serratam contracta, papyraceis, inferne pallidis, costa fusca squamulis nonnulis fissis interdum piliferis ornata, lamina sparsisime squamulifera, venis tenuibus congestis, recurrentibus omnino carentibus; soris minutis, congestis, vix 1 mm a margine remotis, sporangiis 6–8.

SAN CHRISTOVAL, Waimamura, *Brass 2711.* This may be the fern responsible for the report of *A. caudata* De Vr. from the Bismarck Archipelago; but the Philippine type collection of that species has the pinnules gradually narrowed to coarsely serrate caudate tips 3 cm or more in length, the venation is lax, and recurrent veinlets are present; and still there is appreciable resemblance.

Brass's field note reads: "Usually found on the slopes of small ravines in the hills; very common. A typical large plant has a short, erect trunk 30 cm high by 46 cm diam. across the persistent auricles and bases of old fronds and young, large, widely spreading fronds. Typical frond 5.5 m long by 2.75 m broad. Pinnæ 24; lowermost 1.03 m long; longest (slightly below middle of lamina) 1.30 m; terminal one, 58 cm. Stipes 2.7 m long by 7 cm diam. at base, 3-angled. Stipe and rachis densely covered with short brown scales."

LEPTOPTERIS LAXA Copel. sp. nov. Plate 5.

Teste Kajewski, arbor trunco 175 cm alto et fronde 125 cm longa; rhachi sparse fibrillosa; pinnis medialibus 20 cm longis, 3.5–4 cm latis, acuminatis, sessilibus, rhachibus sat dense pubescentibus nisi apud basin anguste alatis; pinnulis anguste adnatis, usque ad 2 cm longis, 5 mm latis, obtusis, ad alam costae pinna-

tifidis, segmentis plerisque acutis, 1 mm latis, inferioribus remotis furcatis.

BOUGAINVILLE, Kupei Gold Field, altitude 1,200 meters, *Kajewski 1737*.

The collection consists of the upper part or apex of three fronds. The lower pinnæ of these fragments are more dissected than those of *L. Fraseri* or *L. Wilkesiana*, and distinct in appearance, because the lower segments of the lower pinnules are separated by more than their own width, connected by a wing of the costa no wider than the half-lamina of the segments. The denser pubescence of the lower part of the secondary rachises is in contrast with the sparse hairiness of the main rachis. In both of these respects, *L. laxa* is more distinct from the two related species than they are from one another.

In fact, I mistrust the specific distinctness of *L. Fraseri* and *L. Wilkesiana*. Fiji specimens representing the latter may have almost naked axes; while one New Caledonia collection in hand, *Le Rat 2819*, is as deeply dissected as is usual in Fiji specimens, and has the lower pinnæ strongly deflexed and moderately reduced.

GLEICHENIA KAJEWSKYI Copel. sp. nov. Plate 6.

Fronde monopodiale, ramis alternantibus statura definita iterum furcatis, lamina pectinata per internodia brevia usque ad 4 evoluta, axibus inferne squamulis appressis ovatis laceris obtectis; segmentis 10–14 mm longis, 2 mm latis, abrupte acutis, papyraceis, pilis minutis inflexis ciliatis, costis utroque latere squamulosis haud piliferis; soris costalibus, parvis, medio longitudine segmentarum fere contiguis, nec apices baseos appropinquantibus.

GUADALCANAR, Tutuve Mountain, altitude 1,200 meters, *Kajewski 2671*.

One of the group of *G. flagellaris*, already represented in this area by *G. oceanica* and *G. Brackenridgei*. Because of the fragmentary nature of specimens of other species, I do not know how distinctive this one may be in general plan of the frond; however that may be, the pubescence is diagnostic. At each forking of the main axis are borne a few, stipulelike, simple and pinnatifid leaflets 10 to 15 mm long.

CYATHEA VITTATA Copel. sp. nov. Plate 7.

C. contaminanti affinis; stipite basin versus paleis 2–25 mm longis, albido-fulvis anguste lanceolatis attenuatis vestito, sursum laete castaneo, furfuraceo glabrescente, irregulariter spinuloso; rhachi valida, castanea, densius spinosa; pinna mediale 70 cm

longa, pedicello 2 cm longo protensa, acuta, rhachi spinulosa. glabra vel glabrescente; pinnulis infimis pedicellatis paullulo reductis, plerisque 11.5 cm longis, 2 cm latis, sessilibus basi paullo dilatatis, brevi-acuminatis, basin versus pinnatis alibi profunde pinnatifidis, rhachi resp. costa inferne deorsum castaneo-furfuracea, medio longitudine saepe glabrescente, apicem versus more costularum squamulis et pilis ornata; segmentis usque ad 30-paribus, 3 mm latis, lineari-ellipticis, subfalcatis, integris, subcoriaceis, superne atroviridibus nudis, inferne ad costam piliferis, ad costam venasque squamulis pallidis bullatis obsitis; venulis 12- ad 14-paribus, distalibus simplicibus aliis furcatis; soris inframedialibus, contiguis, nudis.

YSABEL, Tiratoña, altitude 600 meters, *Brass 3313.* "Common. Tree fern, often more than 10 m tall; trunk usually unbranched; very basal part thickly covered with a dark mass of small aërial roots; remainder of trunk bare to within 0.5 m of top, with a number of shallow pits below each conspicuous leaf-scar; summit softly scaly. Fronds 10 to 12, spreading, 3 m or more long, including stipe about 60 to 70 cm long; pinnæ about 30, the lowest 4 or 5 set wide apart. Native name, *tonasagi.*"

This may possibly be *C. bongardiana* (Mett.) Domin, never adequately described, merely [2] said to differ from *C. lunulata* in having "segments broader, entire, rather glaucous below, with copious scattered scales, veins more distant and obscure." The many minute scales are a striking character; but the venation of *C. vittata* is very close, and identity in other respects may not be assumed.

CYATHEA BAROTU Copel. sp. nov. Plate 8.

C. vittatae affinis, trunco breviore, fronde ampliore, paleis; stipitis angustioribus fere albis, et pilorum absentia distincta; stipitis base paleis albidis 1–25 mm longis, maximis 1 mm latis, vestita; pinna mediale 90 cm longa; pinnulis plerisque 16 cm longis, 3–3.5 cm latis, pinnulis ^{ii}, resp. segmentis 3–3.5 mm latis, infimis inciso-crenatis, aliorum parte fertile crenata; sterile saepe dilatata subintegra, tenuiter papyraceis, inferne sat dense squamuliferis; venulis pinnatis, ramis plerumque 3, rarius 2 vel 4.

SAN CHRISTOVAL, Balego-nagonago, altitude 350 meters, *Brass 2822.* "Trunk about 3 m tall, covered with short, brown adventitious roots, and toward the summit densely matted pale brown scales; leaf-scars very conspicuous. Fronds about 5 m long in-

[2] Syn. Fil. 41.

cluding stipes, and 1.5 m broad near middle. Stipes 1 mm long, lower end brown, covered with pale, soft scales; lower surface of upper end of stipe and whole of rachis brown, upper surface glaucous-green. Natives eat the young, unopened fronds, either boiled or roasted. Local name, *barotu.*"

CYATHEA ACICULOSA Copel. sp. nov. Plate 9.

Stipite 40–50 cm longo sursum pinnis nonnulis abortivis onusto paleis tenuissimis 3 cm longis basi 1 mm latis ochraceis dense vestito, sursum inferne demum glabrescente etiam rhachibusque frondis et pinnarum asperis, fusco; pinnis inferioribus remotis decrescentibus stipitulatis, medialibus sessilibus, 50 cm longis, 11 cm latis sensim brevi-acuminatis, rhachibus atropurpureis fusco-furfuraceis; pinnulis numerosissimis, sessilibus, 5.5–6 cm longis, 14 mm longis, basi truncatis, apice abrupte acutis, fere ad apicem pinnatis, rhachillis paleis stramineis anguste ovatis 0.6 mm longis et minoribus obscuris vestitis; pinnulis ^{II} ca. 20-paribus, 7 mm longis, vix 2 mm latis, obtusis, plerisque basi truncatis superioribus adnatis, inferioribus basi inciso-crenatis, alibi crenatis vel apices versus integris, subcoriaceis, inferne pallescentibus, costis deorsum squamulis paucis vestitis; venulis ca. 7-paribus, inferioribus soriferis prope costam furcatis; soris costularibus sed faciem pinnulae complentibus, indusio fulvo, tenue, mox irregulariter fisso.

SAN CHRISTOVAL, Hinuahaoro, altitude 900 meters, *Brass 2887.*

"Native name, *baratu.* Tree fern, in mountain forest, only one plant seen, with thick trunk, and four rather erect fronds 2.7 m long, with spread of 1.2 m. Stipe and lower rachis covered with long brown scales, stipes only about 15 cm long; one or two very small barren pinnæ at base of rachis; pinnæ of next 40 to 50 cm of rachis all deciduous." There is no material discrepancy in measurements between the field note and the Latin description; Brass calls the region of abortive and deciduous pinnæ a part of the rachis, which it really is, but for descriptive purposes I prefer to call it part of the stipe, as it is in a physiological sense.

This species has some resemblance, and probably affinity, to *C. auriculifera,* of New Guinea, and to *C. celebica.*

CYATHEA ALTA Copel. sp. nov. Plate 10.

Eualsophila trunco altissimo, stipite speciminis 20 cm longo, 1–15 cm crasso, basi ad truncum decurrente paleis fusco-castaneis 1–15 cm longis lineari-acicularibus vestito, alibi furfuraceo,

spinuloso, superne (sicco) atrocastaneo, inferne rhachibusque brunneis; pinnis infimis remotis 15 cm longis, stipitulo 2 cm longo; pinnis medialibus sessilibus, 50 cm longis, 18 cm latis, in apicem lanceolatum acuminatam vix pinnatam abrupte contractis, rhachi furfuracea asperula; pinnulis sessilibus, 8–9.5 cm longis, basi 15 mm latis, argute serrato-acuminatis, fere ad costam pinnatifidis, costa inferne et paleis lanceolatis 0.5–1.5 mm longis castaneis pallido-marginatis et squamulis minutis vestito; segmentis 2 mm latis, obtusis vel subacutis, serratis, papyraceis, superne atroviridibus, inferne pallido-viridibus, costulis deorsum squamuliferis; venulis ca. 12-paribus, plerisque furcatis et soriferis; soris costularibus, ferrugineis, nudis, latetudinem segmenti fere complentibus.

YSABEL, Tiratoña, altitude 600 meters, *Brass 3330*. "Local name, *toñahatotogo*. Tree fern 15 m or more high; several slender stems erect from a root-covered common trunk; lower part or sometimes most of the stem free of frond-butts and densely root-covered; upper part rootless, and completely covered by appressed frond-butts. Fronds 10 to 12, wide-spreading, on average less than 3 m long; stipes 40 to 60 cm long, flattened, edges and upper surface of lower part green. Sori very dark brown." Discrepancies between the description of the fresh plant and the specimen are noted.

This has the aspect, as well as the technical characteristics, of the *Alsophila* group of Australia and Melanesia. It differs from most species in the narrower segments, from *A. MacArthurii* in the scales, from *A. samoensis* in being spiny.

CYATHEA SCABERULIPES (v. A. v. R.) Domin.

Cyathea scaberulipes (v. A. v. R.) DOMIN, Acta Bot. Bohemica 9 (1930) 174.

Alsophila scaberulipes v. A. v. R., Nova Guinea 14 (1924) 2.

SAN CHRISTOVAL, Star Harbor, *Brass 3124*.

Remarkable for its herbaceous texture and for the variety of scales and hairs on the axes, in both of which respects the specimen fits the description. The segments are serrate rather than crenate. And the paraphyses protrude beyond the young sori and provide a cobwebby covering for the young sorus.

The field note: "Common in hill rain-forests. Slender tree-fern, 2 to 3 m tall; trunk 5 to 7 cm in diam. at top, densely covered with pale, appressed scales. Fronds 10 to 12, not widely spreading, average length 1.8 m inclusive of stipe 50

to 60 cm long. Base of stipe appressed to trunk, thickly covered with long pale scales."

CYATHEA MELANOCLADA (v. A. v. R.) Domin.

Cyathea melanoclada DOMIN, Acta Bot. Bohemica 9 (1930) 174.
Alsophila melanocaulon v. A. v. R., Nova Guinea 14 (1924) 1.

Brass 2880, from Hinuahaoro, San Christoval, altitude 900 meters, may be identical with this New Guinea species. If so, one conspicuous feature, the restriction of the sori to the proximal part of the frond, escaped description. *Cyathea Hornei* shares this feature, but has the sterile "segments" closely placed, the pinnules pinnate only near the base. I would describe Brass's plant as freely tripinnate, with narrowly winged tertiary rachises; but van Alderwerelt may mean the same thing by "Pinnulae . . . dimidio inferiore pseudo-pinnatae . . . Segmenta remota. . . . inferiora . . . brevissime petiolulata, . . . basi truncata." Both *C. melanoclada* and *C. Hornei* are coriaceous, while the plant in hand is rather herbaceous. *Alsophila dissitifolia* Baker, described from Fiji, must also be very similar, if not identical with one of these.

Brass's field note reads: "Native name, *warotu.* Trunk 2 to 3 m high, 6 to 8 cm in diam., pink within when cut, covered with persistent leaf-bases. Fronds about 10, widely spreading, 2.1 m long. Stipe and rachis black, with shining brown scales. Lower very small pinnæ deciduous; only the lowermost 5 or 6 persistent pinnæ fertile." The scales are really, as described by van Alderwerelt, black, with lacerate brown margin. Dwarfed, mostly deciduous pinnæ extend down to the base of the stipe.

DRYOPTERIS ODONTOPHORA Copel. sp. nov.

Frondis lamina solummodo adest anguste ovata, (teste lectore usque ad 1 m) 50 cm longa, quadripinnata, glabra, papyracea, inferne paullo pallidiore, rhachibus stramineis, pinnis, pinnulis [i] et pinnulis [ii] breviter stipitulatis, pinnulis [ii] infimis 1 cm longis, oblongis, subincisis, segmentis ultimis sparsissime praecipue ad apices obtuse vel argute dentatis; venis paucis inconspicuis; soris plerisque venulas terminantibus, nudis.

GUADALCANAR, Vulolo, Tutuve Mountain, altitude 1,200 meters, *Kajewski 2687,* May 14, 1931.

Very near the Fijian *D. Gillespiei,* from which it is distinguished by the sparsely but conspicuously dentate segments. *Dryopteris maxima* (Baker) C. Chr., of Fiji, and *D. arborescens* (Baker) O. K., of Samoa, must be similar, but both are described

as indusiate; I find no trace of an indusium on young sori of *D. odontophora.* The stem is presumably stout and suberect.

DRYOPTERIS DOODIOIDES Copel. sp. nov. Plate 11.

Caudice erecto, inter baseos stipitum paleis ovatis parvis integris castaneis vestito; stipitibus fasciculatis, ca. 5 cm altis, deorsum obscuris glabrescentibus, sursum rhachibusque plumbeis dense pallide pubescentibus; fronde ca. 20 cm alta, 4 cm lata, pinnata, deorsum angustata pinnis subremotis, apice pinnatifida integrescente acuta; pinnis usque 30-paribus, medialibus 2–2.5 cm longis, 4–5 mm latis, obtusis vel subacutis, basi dilatatis, brevissime pedicellatis, decidue ciliatis, margine variabile aut subintegra aut irregulariter dentato-serrata, papyraceis, costa minute puberula; venis aut rectis aut fulmeniformi-dissipatis, inferne conspicuis, venulis plerumque 2-paribus infimis soriferis anastomosantibus; soris more Doodyae strictissime ordinatis, parvis sed fere contiguis, indusio reniformi-orbiculare, nudo.

SAN CHRISTOVAL, Huru River, altitude 50 meters, *Brass 3004.* "On rocks in the rain forest."

There is some resemblance to the Papuan *Dryopteris aquatilis,* but this may be due to a condensation of the frond in adaptation to a physiologically similar environment.

DRYOPTERIS OXYOURA Copel. sp. nov. Plate 12.

Caudice breve, erecto; stipite 50 cm alto vel altiore, ad basin imam paleis fuscis paucis et parvis vestita, sursum stramineo, decidue furfuraceo, pinnulis paucis remotis vestigialibus ornato; fronde ultrametrale altitudine, abrupte acuminata apice pinnatifida, rhachi minute furfuracea; pinnis superioribus basi oblique, acroscopice angustis, cuneatis, inferioribus 25 cm longis, lineari-lanceolatis, 3 cm latis, basin versus angustatis, apice in cadam integram acutissinam sensim angustatis, ultra mediam laminam pinnatifidis, herbaceis, costa inconspicue furfuracea, alibi glabris; segmentis 3–4 mm latis, subintegris, obtusis; venis ca. 10-paribus, plerumque 2-, rarius 3-paribus anastomos-antibus; soris ad venulas fere omnes medialibus, indusio parvo, minute setoso, sporangiis setosis.

SAN CHRISTOVAL, *Brass 2696,* absque commentariis.

In the general group of *D. truncata,* more deeply cut than most of its relatives, peculiar in the narrowed bases of the inframedial pinnæ; the shortened segments are more numerous than in the case of *D. Brackenridgei,* so that the effect is not that of a rounded base.

DRYOPTERIS MALODORA Copel. sp. nov. Plate 13.

D. feroci similis et affinis, setis fulvis, textura (sicca) papyracea, facie inferiore densius setosa, pinnis profundis (ad vel ultra mediam laminam) incisis lobis obtusis, venis 3-paribus anastomosantibus, indusiis nullis distincta; stipite rhachique valde setosis, costis pubescentibus; pinnis usque ad 40 cm longis, 2.5 latis, sessilibus, apice in caudam integram 3 cm longam sensim angustata.

SAN CHRISTOVAL, Huru River, *Brass 2688.*

The collector's field note reads: "Lowlands. Rare. Erect from an underground rootstock protruding just above the ground. Three to five fronds, 8 feet high with spread of 2 feet. Stipes about half the length of the entire frond, bright brown. Pinnæ mostly flatly spreading, but becoming more erect toward base of rachis, the basal pair standing at right angle with rachis. Juvenile unopened fronds a bright golden yellow. Bristles of stipe emit a pungent, objectionable odor when crushed."

DRYOPTERIS MYRIOSORA Copel. sp. nov. Plate 14.

D. Brackenridgei affinis et similis, pinnis ad alam costae vix 0.5 mm latam pectinatis, soris medialibus distincta; rhachi inferne apud insertionem pinnae quaeque aerophoro 1 mm alto praedita; pinnis medialibus 30 cm longis valde acuminatis, 3.5 cm latis, basi abrupte paullo angustatis, stipitulatis; costa straminea superne fusco-setulosa, inferne primo pubescente, dumum furfuracea; segmentis basi 3–4 mm latis, deinde angustatis, acutis, minute decidue ciliatis, acroscopicis fere rectangule distantibus falcatis, basiscopicis erecto-patentibus, incurvis, costulis inferne pallide setulosis; venulis ca. 30-paribus, fere omnibus soriferis; soris minutis, indusiis persistentibus aut nudis aut ad insertionem decidue setosis.

BOUGAINVILLE, Kupei Gold Field, altitude 1,000 meters, *Kajewski 1769.*

"A fern with fronds one and three quarters meters long, growing out of the ground. Five or six fronds form one plant." The lowest one or two segments are sometimes free.

Dryopteris Schlechteri Brause should be distinguished by less persistent indusia and obtuse segments, as well as by costular sori. This, *D. falcatopinnula* Copel., *D. alta* Brause, the species here described, and *D. Brackenridgei* form a well-marked group, ranging from Papua to Tahiti.

SPHAEROSTEPHANOS UNIJUGA Copel. sp. nov. Plate 15.

Rhizomate adscendente, breve, valido; stipitibus caespitosis, infra auriculas 6 cm longis, paleis atrocastaneis lanceolatis 6 mm longis puberulis et ciliatis vestitis, deinde usque ad pinnas normales 40 cm altis, pubescentibus, pinnis valde reductis plerisque hastatis deorsum decrescentibus et praecipue ibidem approximatis ornatis; fronde ultra 1 m alta, 30 cm lata, bipinnatifida, ubique setoso-pubescente, apice pinnatifida valde attenuata; pinnis haud remotis, sessilibus, 16 cm longis, 18 mm latis, in caudas integros 3 cm longas attenuatis, rhachi versus $\frac{2}{3}$ ad costas pinnatifidis, lobis oblongis subfalcatis, 3 mm latis, lobo infimo acroscopico elongato; venis ca. 11-paribus, infimis solummodo anastomosantibus; soris medialibus, indusiis oblongis, linea mediale perbreve adnatis, setosis, margine glandulis globosis ornatis.

SAN CHRISTOVAL, Huru River, altitude 100 meters, *Brass 2692*, "Sunny slopes of the valley."

As to the indusium, fairly intermediate between two near relatives, *Sphaerostephanos polycarpa* and *Dryopteris sagittifolia*, distinct from both in the single pair of anastomosing veinlets, the second pair ending above the sinus. In Christensen's Index *Nephrodium microchlamys* Baker appears as a synonym of the former; its venation, as described, is like that of the plant in hand, but the description is otherwise very different—no reduced lower pinnæ, etc. Crowding of the lowest reduced pinnæ or auricles has been noted by Christensen on another relative, *D. polytis*, of Celebes.

Sphaerostephanos as a small genus blends with *Dryopteris* in its present usual sense. If, however, one be indisposed to recognize its distinctness as a small genus, it may still be maintained as a large one in any attempt to dismember *Dryopteris*.

DENNSTAEDTIA TRIPINNATIFIDA Copel. sp. nov. Plate 16.

Rhizomate repente, 6 mm crasso, pilis crassis brevibus vestito; stipite 1 m alto, ad basin nigram fere 1 cm crassam spinis plerisque deflexis 2 mm longis dense munito, sursum gracilescente spinulis sparsis in tubercula nigra decrescentia aspero, facie ventrale sulcata castanea, alibi atropurpureo, nitido; fronde 75 cm alta, rhachi inerme; pinnis suboppositis, remotis, horizontalibus, sessilibus, ad rhachim articulatis, majoribus 35 cm longis, 10 cm latis; pinnulis infirmis reductis, sequentibus 6 cm longis, basi subsessile 15 mm latis, deinde in caudam valde protractam

sensim angustatis, deorsum profunde oblique pinnatifidis, costa inferne pilulifera, lobis modo remotis, oblongis, ca. 4 mm latis, apice rotundatis, nudis, inferne pallidis, subcoriaceis; soro venulam infimam lobi insidente, minuto.

SAN CHRISTOVAL, Hinuahaoro, altitude 900 meters, *Brass 3043*, "1.2 to 1.5 m high. Fronds few, spreading. Upper surface of stipe and rachis bright-brown, lower almost black. Fronds very dark green." GUADALCANAR, Vulolo, Tutuve Mountain, altitude 1,200 meters, *Kajewski 2689*.

Cyathea erythrorachis, as identified for me by its author, Dr. Christ, is not quite tripinnate, but has conspicuously narrower and closer lobes, and lighter and less spiny stipes. The other species of the group, including *D. glabrata* and *D. Rosenstockii* from New Guinea, are all believed to be tripinnate.

TAPEINIDIUM TENUIUS Copel. sp. nov. Plate 17.

Rhizomate 2 mm crasso, pilis brevibus castaneis vestito; stipitibus 20–50 cm altis, avellanis, nudis; fronde deltoidea, 20–50 cm alta, 20–35 cm lata, quadripinnatifida; pinnis infimis aut deltoideis, aut (frondium maximarum) late lanceolatis, sequentibus oblique ovatis caudatis; pinnulis usque 6 cm longis, 1 cm latis, caudatis, basi angustatis; pinnulis [11] inferioribus profunde oblique incisis lanceolatis, aliis potius late serratis ca. 1 cm longis 1.5 mm latis, decurrenti-adnatis; soris dentes fere omnes complentibus, parvis, indusio obconico.

SAN CHRISTOVAL, Hinuahaoro, altitude 900 meters, *Brass 3025*. YSABEL, Tiratoña, altitude 600 meters, *Brass 3335;* this is a single very large frond, the smaller figures in the dimensions given in the description applying to the type collection.

More finely dissected than any previously known representative of the genus. *Tapeinidium pinnatum* var. *tripinnata* Ros., of New Guinea, approaches it most nearly. Quadripinnatifid New Guinea plants called *T. Denhami* may be the species here described, but the latter is distinct from the Fiji plant properly called *T. tenue*, of which *T. Denhami* is a synonym.

HISTIOPTERIS HERBACEA Copel. sp. nov. Plate 18.

Rhachi laete fusca; auriculis 18 mm longis, 12 mm latis; pinna 40-50 cm longa, apice pinnatifida lobis perpaucis; pinnulis ca. 8-paribus, acutis, basi basiscopica cuneatis herbaceis, integris, supremis acroscopice adnatis, medialibus usque ad 16 cm longis, 2.5 cm latis, basi acroscopica rotundato-truncatis, infimis sessilibus utrinque sed oblique cuneatis, venulis ubique anastomo-

santibus reticulam finam efformantibus; soris apices pinnularum haud appropinquantibus, margine angustissima reflexa protectis.

YSABEL, Tiratoña, altitude 600 meters, *Brass 3337*. "Common in well-lighted places in the forests; wide-spreading, rambling fern. Stems brown with glaucous bloom. Fronds very pale glaucous-green."

Although something like the Bornean *H. stipulacea* in the large, entire pinnules, this species is very distinct in texture, and in various minor details—broader pinnules, absence of any basal prongs, etc. The largest pinnules are slightly sinuate in places.

OLEANDRA DIMORPHA Copel. sp. nov. Plate 19.

Rhizomate scandente, gracile, 2 mm crasso, paleis ciliatis basibus nigris fusco-marginatis peltatis apicibus rostratis setiformibus 2–3 mm longis vestitis; phyllopodiis 5 mm longis validis deorsum paleaceis sursum pilosis; stipite 1 cm alto (vel fr. fertilis 15 mm), piloso; fronde sterile 20 cm longa, 4 cm lata, apice abrupte angustata caudata, basi late cuneata vel rotundata, ciliata, papyracea, costa dense et venis sparsius pilis albis 1–2 mm longis obsitis; fronde fertile 40 cm longa, 6–10 mm lata, venatione laxa, soris inframedialibus, indusio reniforme oblique versus marginem aperto.

SAN CHRISTOVAL, Hinuahaoro, altitude 900 meters, *Brass 2916*. "Climbing on tree trunks."

Visible contraction of fertile fronds may sometimes be noted on plants of other species, but this is the first known to be very conspicuous in this respect.

SCYPHULARIA APPRESSA Copel. sp. nov. Plate 20.

Rhizomate latissime repente, 2–3 mm crasso, paleis ciliatis basi imo liberis subacutis deinde dilatatis et puncto nigro mediale affixis apice 2–3 mm longa aciculiformibus fusco-ferrugineis velustate modo nigrescentibus appressis itaque dense imbricatis vestitis; stipite 5–8 cm alta, gracile, nuda; frondibus pinnatis, sterile pentaphylla, pinnis 7 cm longis 1 cm latis, lanceolatis, subsessilibus, acuminatis, subintegris vel infra apicem serratis, fertilis pinnis 10 cm longis, 8 mm latis, acuminatis vel caudatis, basi cuneatis, dentatis; soris infra sinus positis, indusiis ca. 2 mm longis et 1 mm latis, apice truncatis marginem haud attingentibus.

SAN CHRISTOVAL, Hinuahaoro, altitude 900 meters, *Brass 2872*. "Creeping on tree trunks. Very flexible gray stems."

Most like *S. dorsalis* Copel.,[3] of New Guinea, from which it differs in the paler, appressed paleæ and truncate indusia. Both of the fertile fronds seen have the apical pinnæ paired; on one of them one basal pinna is forked.

One of these fronds is monstrous in a very suggestive manner. Of its six pinnæ, three are without fruit on the very narrow tails, which may be regarded as normal. One has two indusiate sori near the tip, normal except as the lack of space makes them nearly parallel to the costa. The fifth bears an elongate dorsal group of naked sporangia. The sixth bears a group of naked sporangia 3 mm long, occupying one margin, and spreading thence over the upper, not the nether, surface. If found sterile, van Alderwerelt's genus *Parasorus,* with the sporangia sunk in the margin, would pass without question as *Scyphularia.*

GRAMMITIS BRASSII Copel. sp. nov. Plate 21.

Caudice paleis lanceolatis fusco-ferrugineis 3 mm longis vestita; stipitibus dense fasciculatis, 5–8 mm longis, validis, pilis brevibus castaneis dense vestitis; fronde usque ad 10 cm longa et 5 mm lata, utrinque angustata, obtusa, firma et vetustate opaca, costa et faciebus ubique setulis minutis inconspicuis vestitis; venis sterilibus simplicibus, fertilibus apud costam furcatis, ramo acroscopico brevissimo soro occulto; soris costalibus parvis, contiguis, orbicularibus, sporangiis setuliferis.

SAN CHRISTOVAL, Hinuahaoro, altitude 900 meters, *Brass 2926,* in moss on tree trunks.

CAMPIUM KAJEWSKII Copel. sp. nov. Plate 22.

C. gregis C. quoyani C. rivulari affine; fronde sterile 30–40 cm alta, 15–20 cm lata, parte apicale magna pinnatifida lobis paucis oblongis; rhachi valida fusca, paleis brunneis lanceolatis 2 mm longis plus minus deciduis vestita; pinnis 5-paribus, 8–10 cm longis, 3.5 cm latis, supremis adnatis integris, medialibus sessilibus subsinuatis, infimis pedicellatis grosse crenatis, acutis, basi diverse rotundatis, nigrescentibus, coriaceis; venis primariis subconspicuis, vix ad marginem protensis, areolis irregulariter 5- vel 6- seriatis inter venas et 6–7 inter costam et marginem interpositis, venulis liberis nullis; fronde fertile aequilonga sed angustiore, pinnis ca. 15-paribus, majoribus 7 cm longis, 1 cm latis, profunde crenatis, basi truncatis.

BOUGAINVILLE, Kupei Gold Field, altitude 1,000 meters, *Kajewski 1763.* "A fern up to one and a half meters high, with sterile and fertile fronds on the same plant; common." From

[3] Univ. Calif. Publ. Bot. 12 (1931) 401.

this note it seems likely that the single sterile frond sent me, with only the upper end of the stipe, is undersized.

Although I am familiar with the instability of form of many *Campium* species, and have in mind the great difference between *C. rivulare* as first described and as more recently collected, *C. Kajewskii* seems to me to be well outside the known or reasonable range of variation either of it or *C. quoyanum,* of which latter *Chrysodium Naumanni* Kuhn is the form geographically nearest.

ANTROPHYUM MEGISTOPHYLLUM Copel. sp. nov. Plate 23.

Rhizomate breve, 3 mm crasso, paleis castaneis 1–2 mm longis haud dense vestito, more generis radicibus oculto; fronde unica visa 65 cm alta, ad apicem rotundo-truncatam cuspidatam 14.5 cm lata, deinde sensim usque ad stipitem vix 5 mm longum angustata, subcoriacea, costa prope mediam laminam aborta; areolis ubique elongatis, venis longitudinalibus omnibus nisi apud marginem soriferis, soris usque ad 20 cm longis rarius inter se connexis; capitibus paraphysium parvis, globosis, rugosis, atrocastaneis.

SAN CHRISTOVAL, Huru River, altitude 50 meters, *Brass 3003.* "On a tree trunk in rain forest, very rare. Four stiff fronds from a tuft of brown roots."

Besides the new species, the collection demonstrates a number of extensions of range, some westward, some eastward. These, and some miscellaneous notes, follow:

OPHIOGLOSSUM PENDULUM Linn.

SAN CHRISTOVAL, Hinuahaoro, altitude 500 meters, *Brass 2902.* "Common, on forest floor." Several fronds suggest the Bornean *O. Moultoni,* but one is within the range of short specimens of *O. pendulum.* I am the less tempted to describe it, because of a suspicion that *O. pendulum* might assume this form if accidentally or otherwise terrestrial.

TRICHOMANES TAENIATUM Copel.

YSABEL, *Brass 3305.* Previously known from the Society Islands.

TRICHOMANES BIPUNCTATUM Poir.

YSABEL, *Brass 3390.*

TRICHOMANES BECCARIANUM Cesati.

SAN CHRISTOVAL, *Brass 2730.* This carries the range eastward, close to that of the similar *T. cultratum.*

CEPHALOMANES OLONGIFOLIUM Presl.

SAN CHRISTOVAL, *Brass 2899.* A common Philippine species, doubtfully reported from Amboyna.

DRYOPTERIS BRACKENRIDGEI (Mett.) O. K.

SAN CHRISTOVAL, *Brass 2799.* Already known from Fiji, Samoa, and Tahiti.

DRYOPTERIS HARVEYI (Mett.) O. K.

SAN CHRISTOVAL, *Brass 2575.* Less dissected and wider pinnæ than the typical plant; hitherto unreported west of Fiji.

DRYOPTERIS MAGNIFICA Copel.

SAN CHRISTOVAL, *Brass 2576.* Already known in Fiji only.

DRYOPTERIS GLANDULOSA (Blume) O. K.

GUADALCANAR, *Kajewski 2679.* Known only from Malaya. The indusia and the golden glands can be detected only on the youngest fronds.

CYCLOPELTIS NOVOGUINEENSIS Ros.

YSABEL, *Brass 3187.* "Common also in San Christoval, but not fertile there at time of my visit." Known from New Guinea only.

TECTARIA ANGULATA (Wild.) C. Chr.

Polypodium angulatum Willd., Sp. Plant. 5 (1810) 105.

SAN CHRISTOVAL, *Brass 2606.* This specimen is exindusiate, as are New Guinea plants so named; otherwise it is like plants with fugacious indusia from farther west.

ATHYRIUM ACCEDENS (Blume) Copel.

BOUGAINVILLE, *Kajewski 1760.* SAN CHRISTOVAL, *Brass 2788.* The latter a very simple form, with secondary areolation.

ASPLENIUM POWELLII Baker (?).

BOUGAINVILLE, *Kajewski 2166.* This fits the description of the Samoan plant (which I have not seen), except that the ultimate segments are longer. As compared with *A. shuttleworthianum* Kze. (at least with *A. multifidum* Brack.), the Bougainville plant is very distinct in appearance, because it has deltoid pinnules of all orders.

ASPLENIUM FEEJEENSE Brack.

BOUGAINVILLE, *Kajewski 1762.* Previously reported from Fiji and Samoa.

ASPLENIUM SCOLOPENDROPSIS F. v. M.

BOUGAINVILLE, *Kajewski 1776.* Somewhat larger than as described, and not absolutely glabrous; known before from Papua.

Phyllitis schizocarpa (Copel.) v. A. v. R., described from Mindanao and reported from Papua, seems to differ from *A. scolopendropsis* in texture, in being opaque, in being slightly more scaly, and in having a short, distinct stipe, but the differences may be apparent only. If removed from *Asplenium*, this fern should be called *Diplora*.[4] The Solomons are the type locality of *D. integrifolia* Baker.

LINDSAYA SESSILIS Copel.

BOUGAINVILLE, *Kajewski 1961*. GUADALCANAR, *Kajewski 2662*. SAN CHRISTOVAL, *Brass 2783*. Originally described as having fronds not over 20 cm long, but a later collection by King had fronds of twice this length. This must be almost doubled again to fit the Solomon Island specimens; but, except in stature and in obviously correlated features, these differ nowise from the Papuan plant. It is distinguished from *L. pectinata* by small sori and vestigial indusia.

CRASPEDODICTYUM GRANDE Copel.

BOUGAINVILLE, *Kajewski 1869*. SAN CHRISTOVAL, *Brass 2865*, with very large fertile simple fronds as well as ternate ones. Described from Papua; now found common in the Solomons.

CRASPEDODICTYUM QUINATUM (Hooker) Copel.

YSABEL, *Brass 3334*, identification not positive. Even after the removal of the West Malayan *C. coriaceum*,[5] on the ground that Hooker surely described at once and under one name two distinct species, it is still difficult to recognize his *Gymnogramme quinata*. He cited three collections, and may have had three species. The first citation is from Vanecolla.

PTERIS BECCARIANA C. Chr.

SAN CHRISTOVAL, *Brass 2689*. Previously known from New Guinea.

HEMIPTERIS WERNERI Ros.

GUADALCANAR, Tutuve Mountain, altitude 1,200 meters, *Kajewski 2681*, common. YSABEL, Tiratoña, altitude 600 meters, *Brass 3328*. Previously known by but two collections in New Guinea.[6] The Ysabel plant has wider segments and a wider costal wing than the type; the Guadalcanar plant has the segments

[4] See Univ. Calif. Publ. Bot. 16 (1929) 73.
[5] Philip. Journ. Sci. 38 (1929) 146.
[6] See Univ. Calif. Publ. Bot. 12 (1931) 396, pl. 51.

separate almost to the costa. Brass's field note reads: "Common name *diamoro*. Three or four very large fronds, erect from a rather small stock supported above ground on stiff roots. Stipes about 1.5 m long and up to 3 cm thick at base; lower part brown, with a green stripe on each side, continued higher as a narrow dark line to base of lamina. Juice from crushed young fronds taken by native women to assist childbirth."

ADIANTUM ROBINSONII v. A. v. R.

SAN CHRISTOVAL, *Brass 2901*. Identical with the type (and only previous) collection, from Amboyna, except in being larger, and accordingly in being tripinnate at base.

ADIANTUM HORNEI Baker.

GUADALCANAR, *Kajewski 2670*. Known from Fiji only.

DRYMOGLOSSUM FALLAX v. A. v. R.

YSABEL, *Brass 3360*. Already known from Amboyna, Buru, Papua, and New Britain.

MICROSORIUM LINGUAEFORMIS (Mett.) Copel.

BUIN, *Kajewski 1972*. SAN CHRISTOVAL, *Brass 2639*. Kajewski's collection includes one stipitate frond with narrowly cuneate decurrent base; and one frond with blade 14 cm wide. The rhizome is slender—on Kajewski's plants only 1 to 2 mm thick; on Brass's, somewhat stouter. It probably serves essentially as an organ of propagation, each frond, with the short stem segment bearing a mass of felted roots within its base, being a practically independent unit.

MICROSORIUM POLYPODIUM SUBGEMINATUM Christ.

GUADALCANAR, *Kajewski 2571*. Known from Papua only. The phyllophore branches are up to 2 cm long, and bear or have borne as many as ten fronds each. The lowest sori are likely to be elongate, which happens in Papua also.

AGLAOMORPHA HERACLEA (Kunze) Copel.

BOUGAINVILLE, *Kajewski 1767*. Previous known range, Malaya and New Guinea.

MERINTHOSORUS DRYNARIOIDES (Hooker) Copel.

BOUGAINVILLE, *Kajewski 1949, 2039*. YSABEL, *Brass 3184*. This was described as glabrous, with citation of specimens from Malay Peninsula and Solomon Islands. The local specimens are glabrous, but those I have seen from western Malaya are pubescent on the upper side of the costæ, etc.

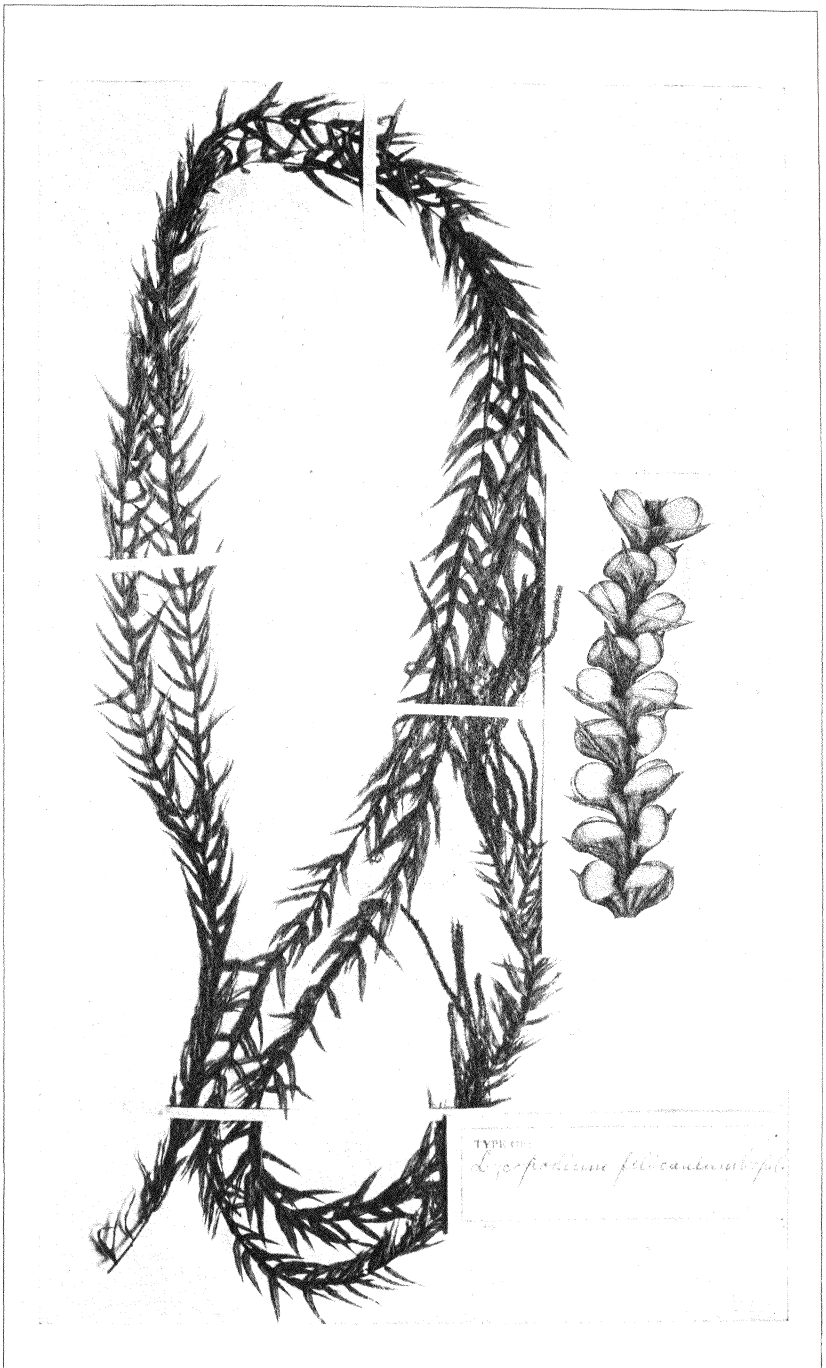
ILLUSTRATIONS

[Drawings for plates 2, 3, 7, 8, 9 and 10 were made by Alicbusan; for all others by Borbe. Photographs by the Department of Agriculture and Commerce.]

PLATE 1. *Tmesipteris oblanceolata* sp. nov., type, × 0.5; sterile and fertile leaves, × 2.5.

2. *Lycopodium filicaulon* sp. nov., type, × 0.4; part of spike, × 8.
3. *Lycopodium longum* sp. nov., type, × 0.4; part of spike, × 8.
4. *Angiopteris microura* sp. nov., type, × $\frac{3}{8}$; detail of pinna, × 3.75.
5. *Leptopteris laxa* sp. nov., type, × $\frac{3}{8}$; pinnule, × 3.7.
6. *Gleichenia Kajewskii* sp. nov., type, × 0.4; detail of segment, × 8.
7. *Cyathea vittata* sp. nov., type, × 0.34; segment, × 3.4; paleæ of axis and veinlet, × 47.
8. *Cyathea Barotu* sp. nov., part of type, × 0.5; distal part of segment, × 5; scales on veinlets, × 115.
9. *Cyathea aciculosa* sp. nov., type, × $\frac{3}{8}$; segment, × 3.7.
10. *Cyathea alta* sp. nov., type, × $\frac{3}{8}$; paleæ, × 37.
11. *Dryopteris doodioides* sp. nov., type, × 0.4; pinna, × 2.
12. *Dryopteris oxyoura* sp. nov., type, × 0.4; segment, × 2.
13. *Dryopteris malodora* sp. nov., type, × 0.4; hairs on stipe, × 0.8; segment, × 2.
14. *Dryopteris myriosora* sp. nov., type, × 0.4; young fertile segment, × 4; large fertile segment, × 1.2.
15. *Sphaerostephanos unijuga* sp. nov., type, × 0.36; segment, × 1.8; sorus, × 10.8; folded indusium, × 7.2.
16. *Dennstaedtia tripinnatifida* sp. nov., type, × $\frac{3}{8}$; detail of pinnule, × 1.85.
17. *Tapeinidium tenuius* sp. nov., type, 0.35; segment, × 3.5.
18. *Histiopteris herbacea* sp. nov., type, × $\frac{3}{8}$.
19. *Oleandra dimorpha* sp. nov., type, × 0.36; detail of fertile frond, × 3.6.
20. *Scyphularia appressa* sp. nov., type, × $\frac{3}{8}$; detail of fertile frond, × 3.7.
21. *Grammitis Brassii* sp. nov., type, × 0.5; detail of frond, × 5; palea, × 25.
22. *Campium Kajewskii* sp. nov., type, × $\frac{3}{8}$; venation, slightly enlarged.
23. *Antrophyum megistophyllum* sp. nov., type, × 0.4.

PLATE 1.



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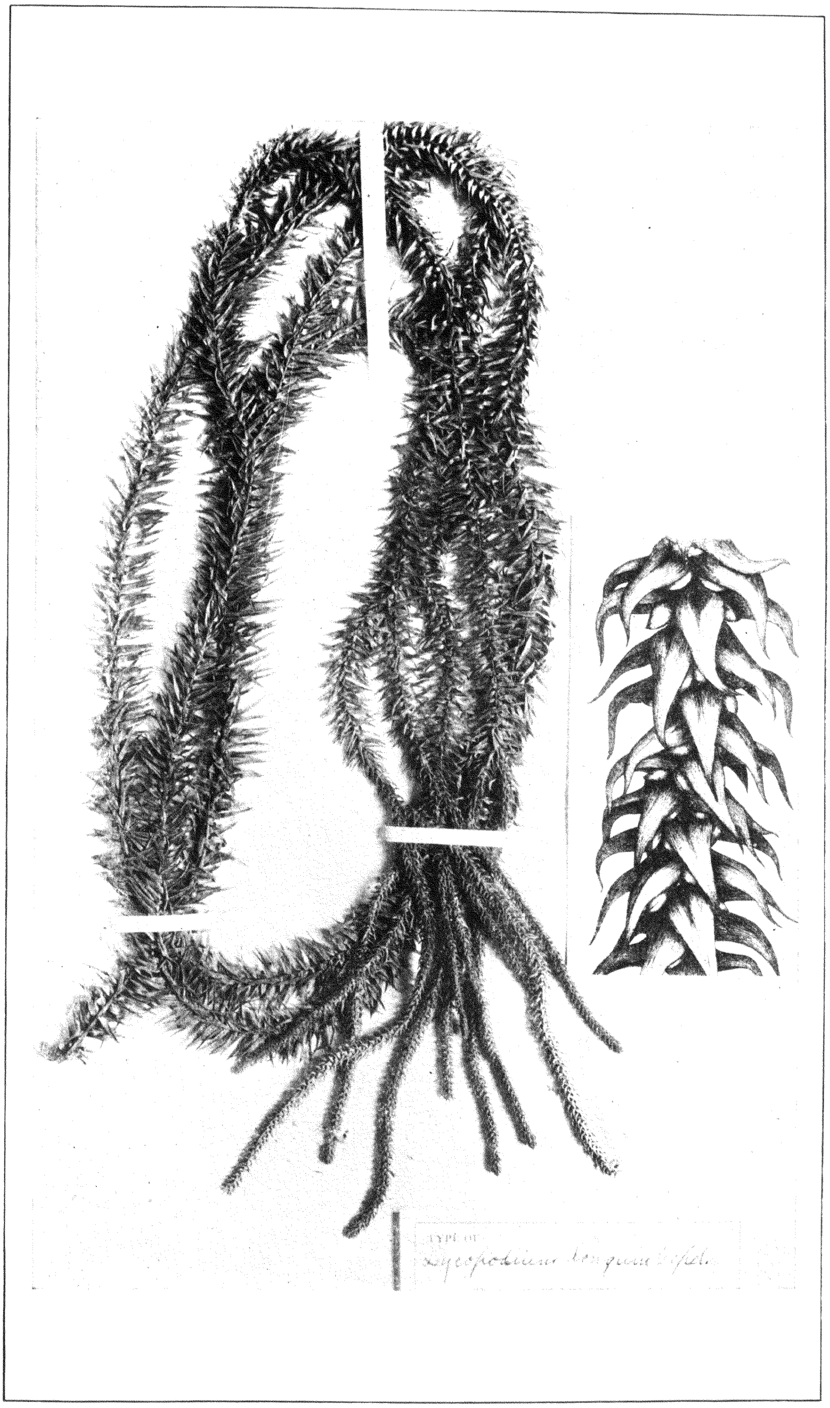

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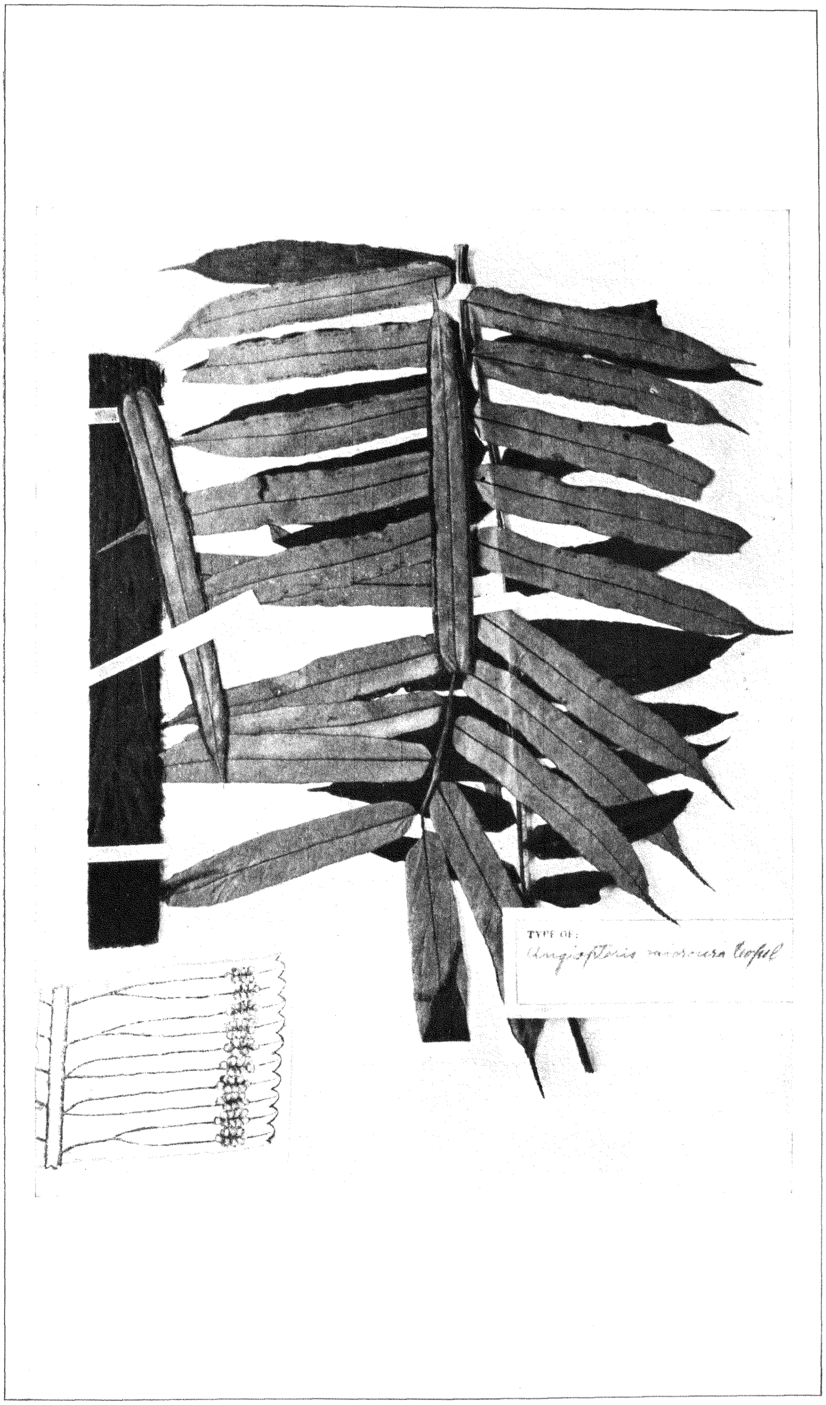

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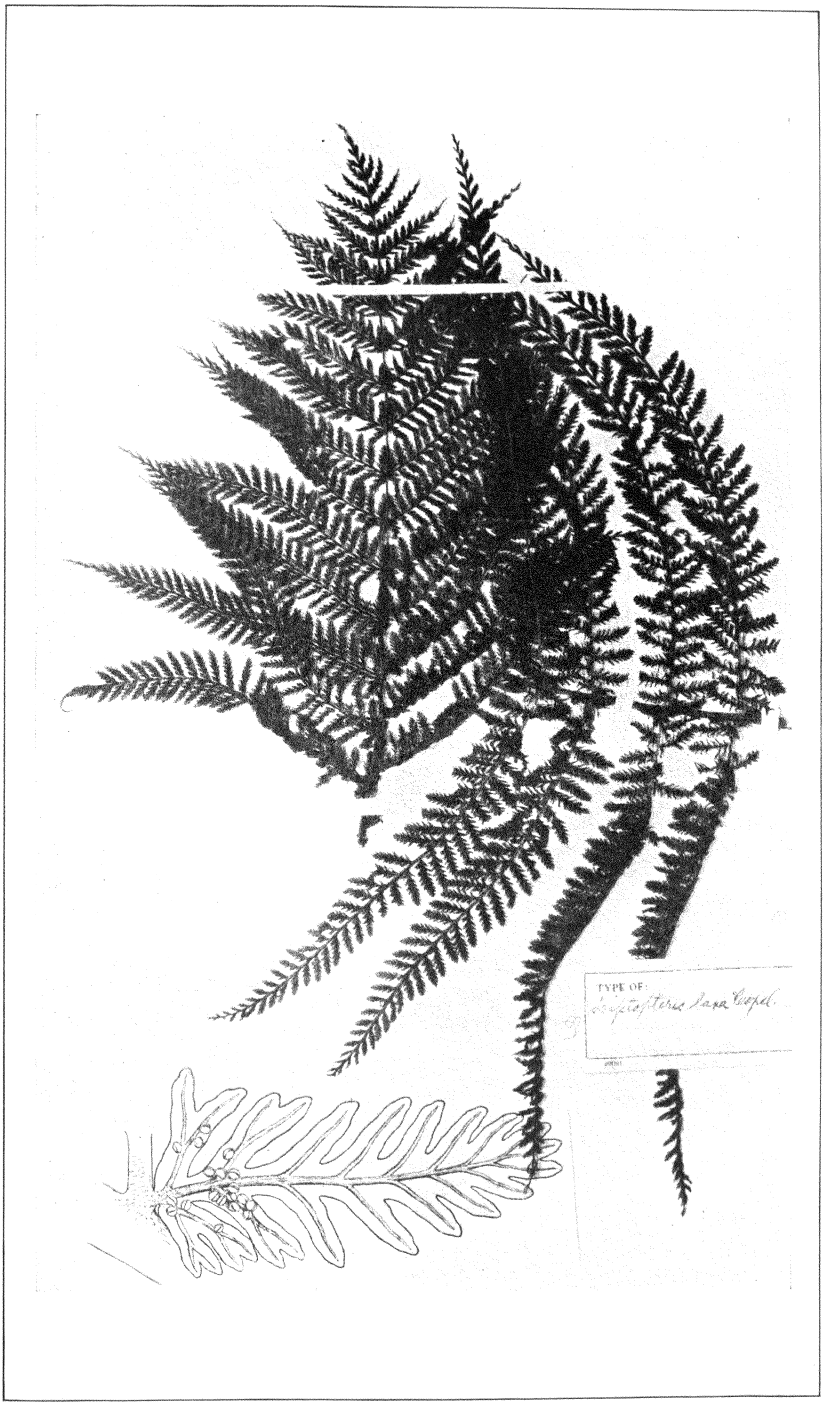

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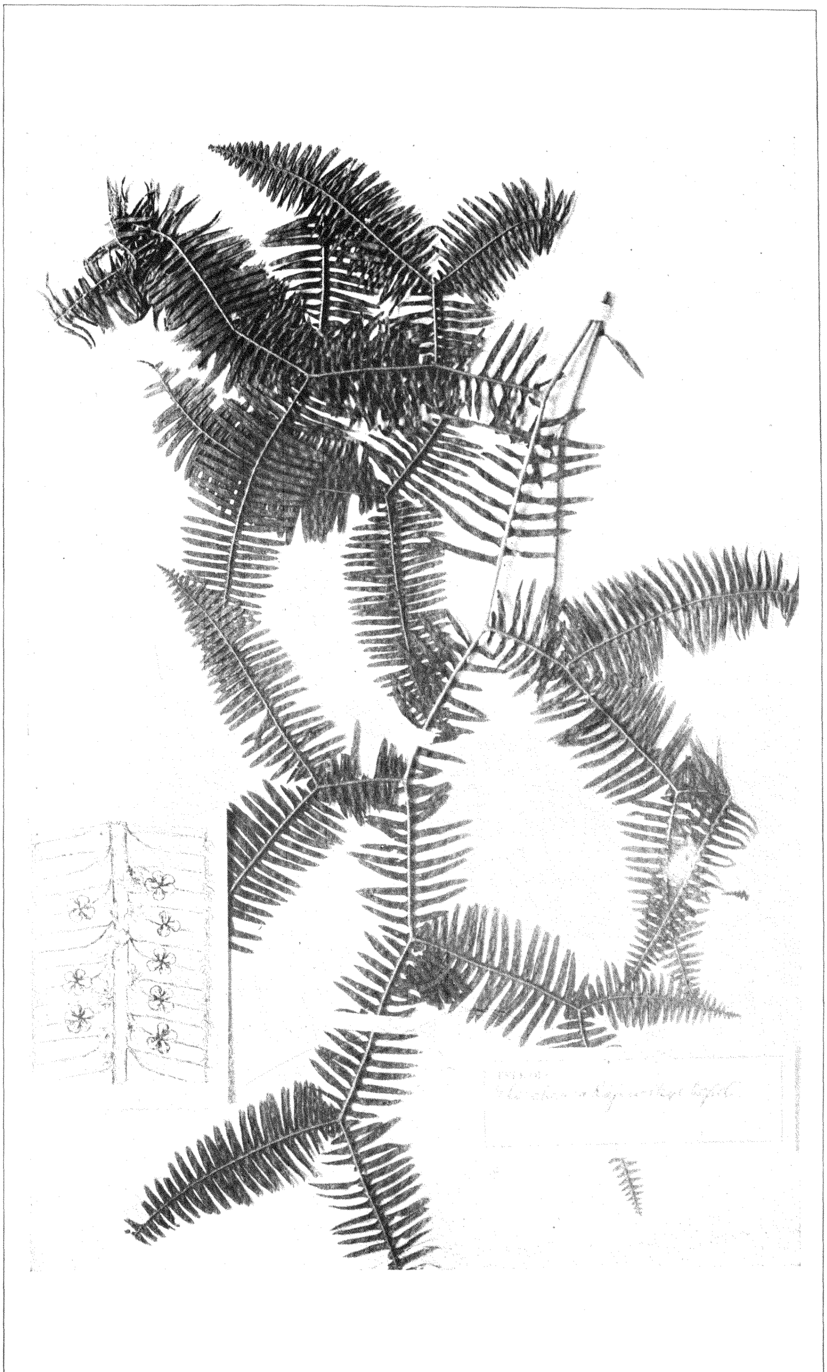

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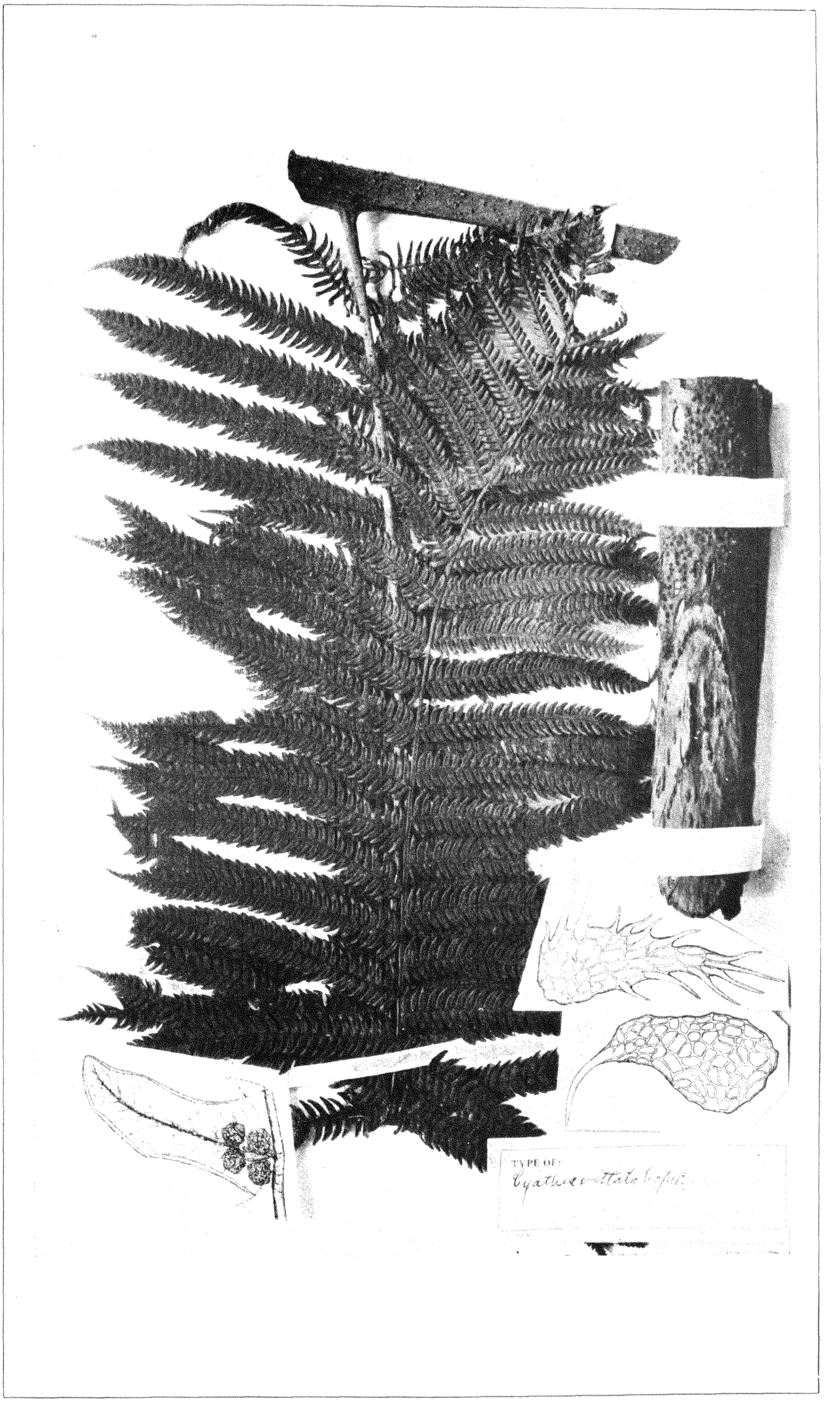

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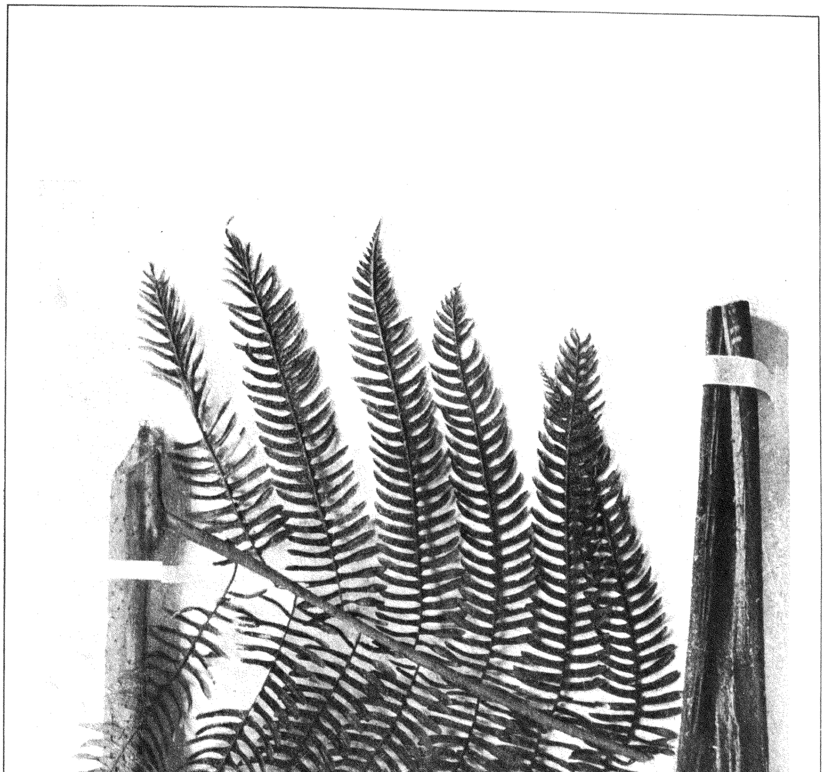
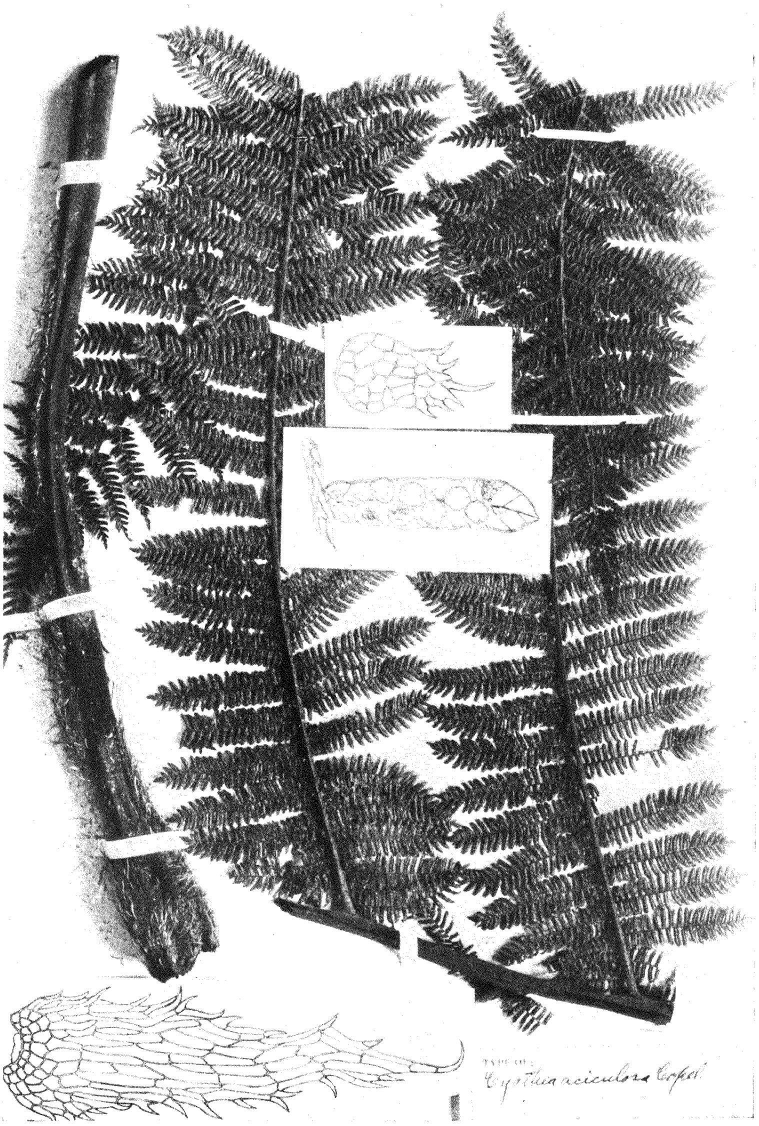


PLATE 8.



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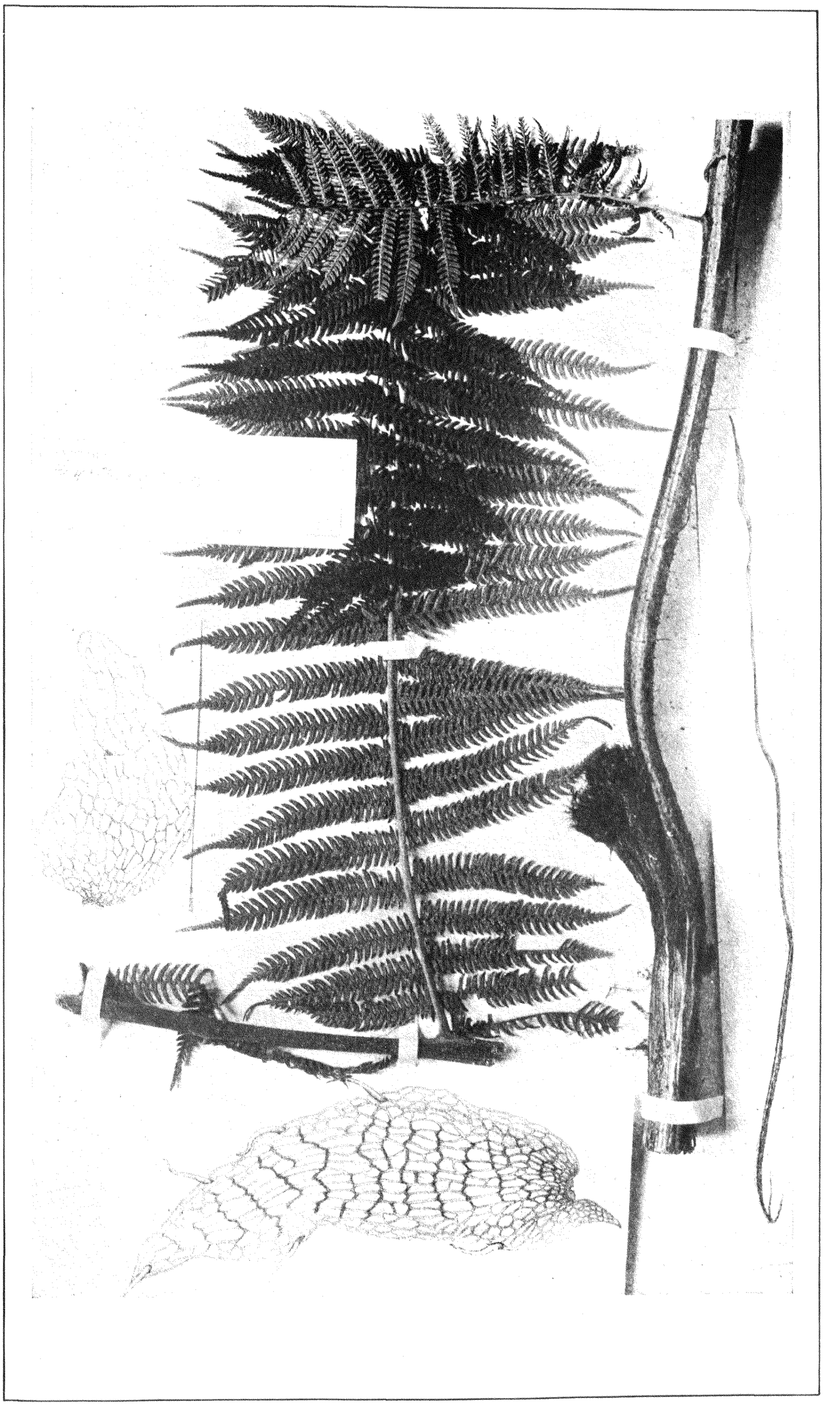

PLATE 10.

PLATE 11.

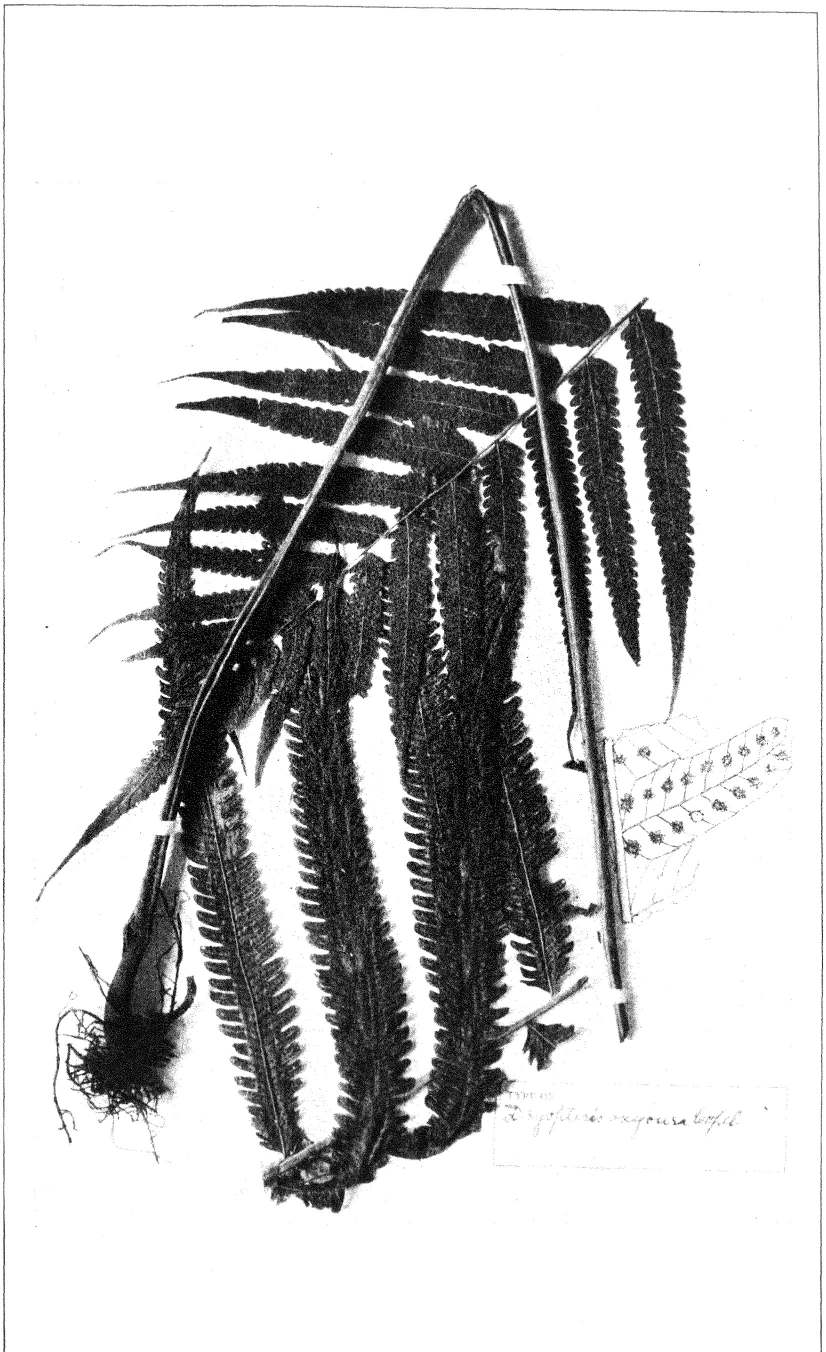

PLATE 12.

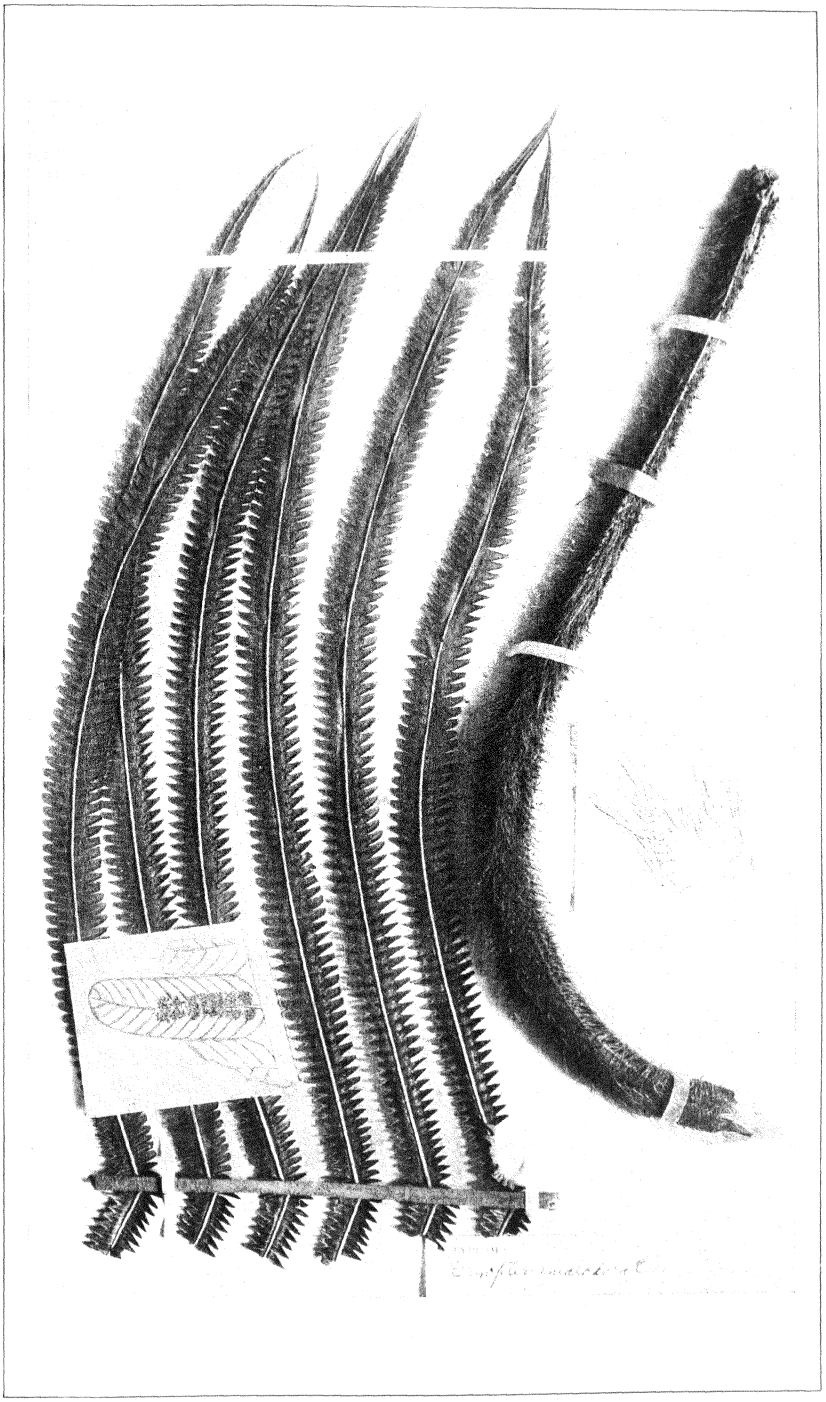

PLATE 13.

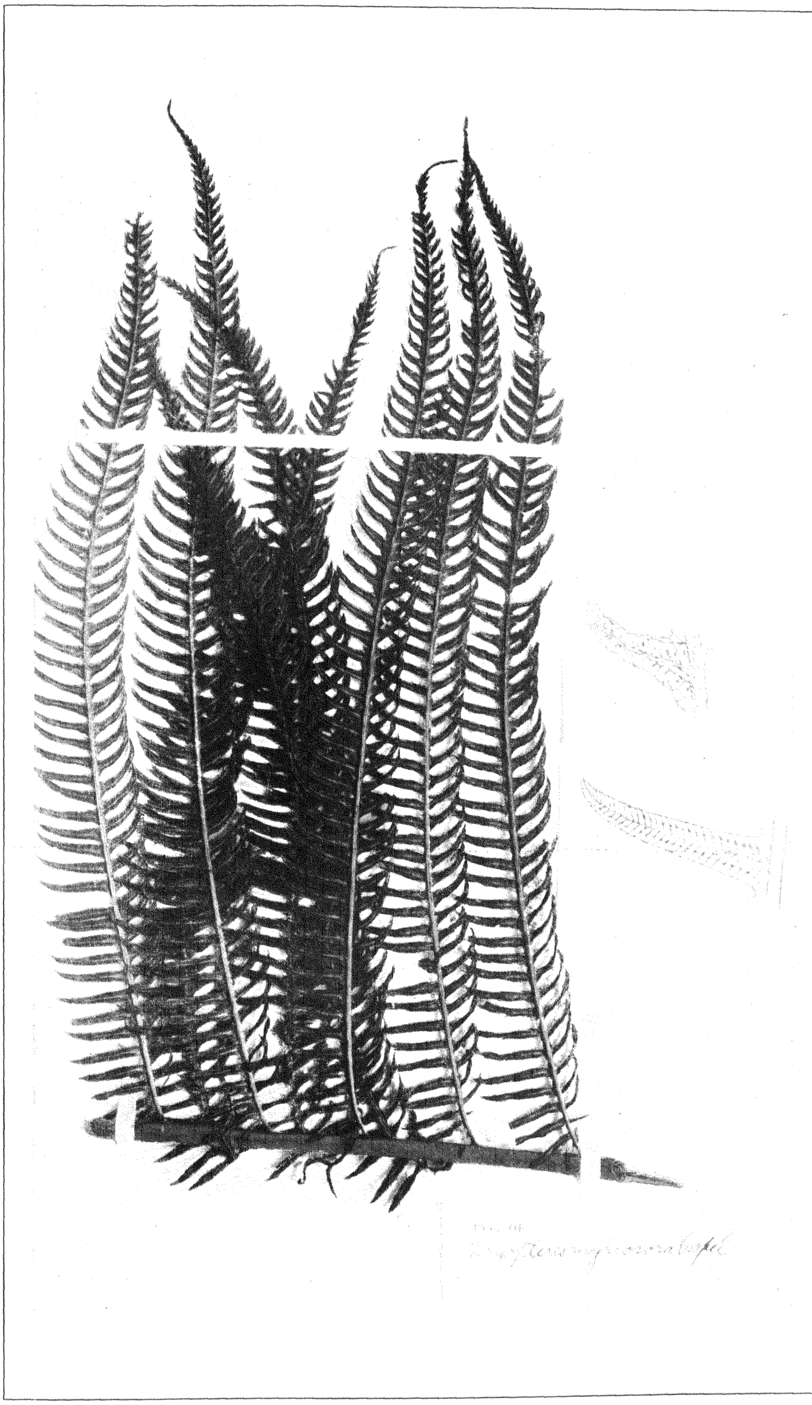

PLATE 14.

PLATE 15.

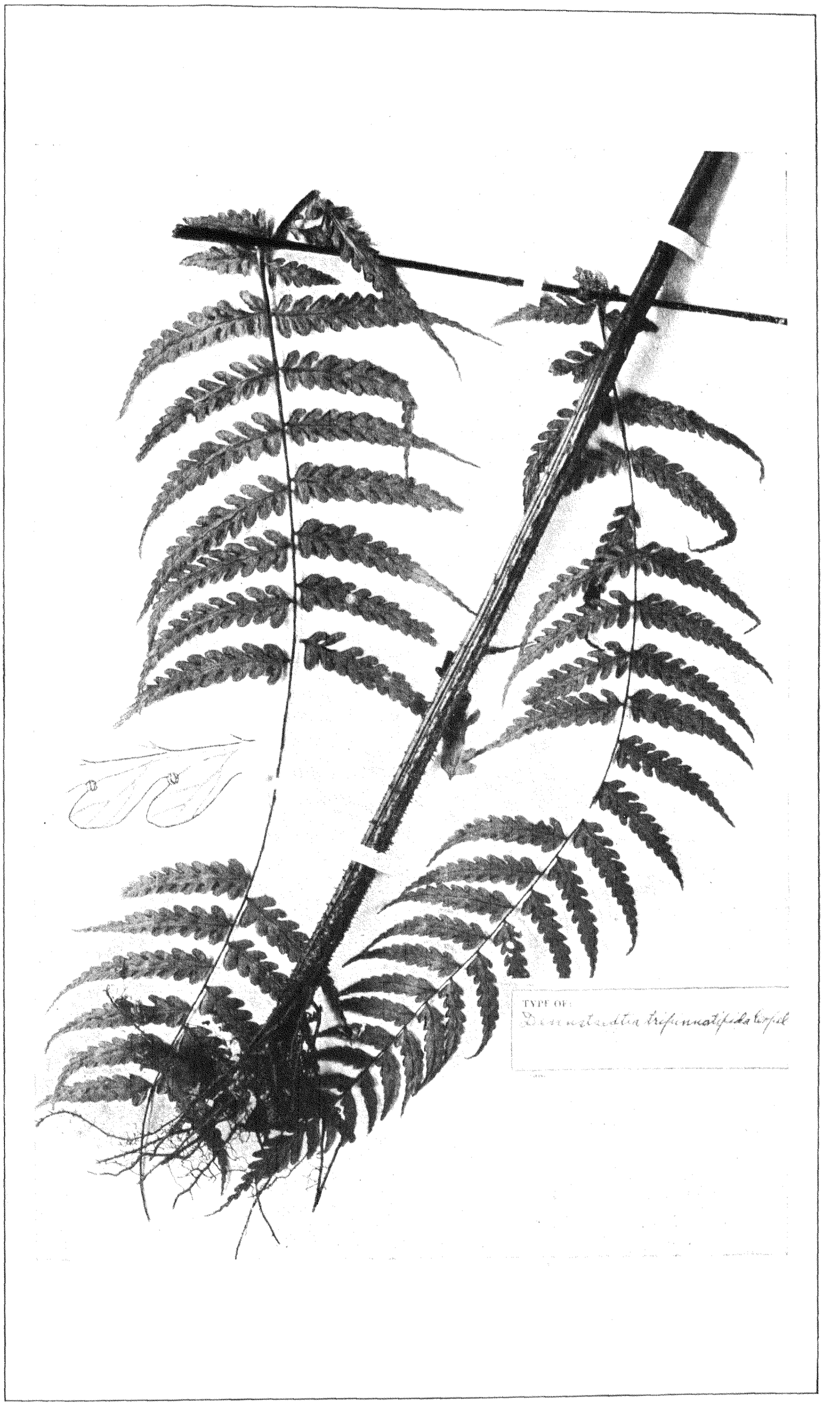

PLATE 16.

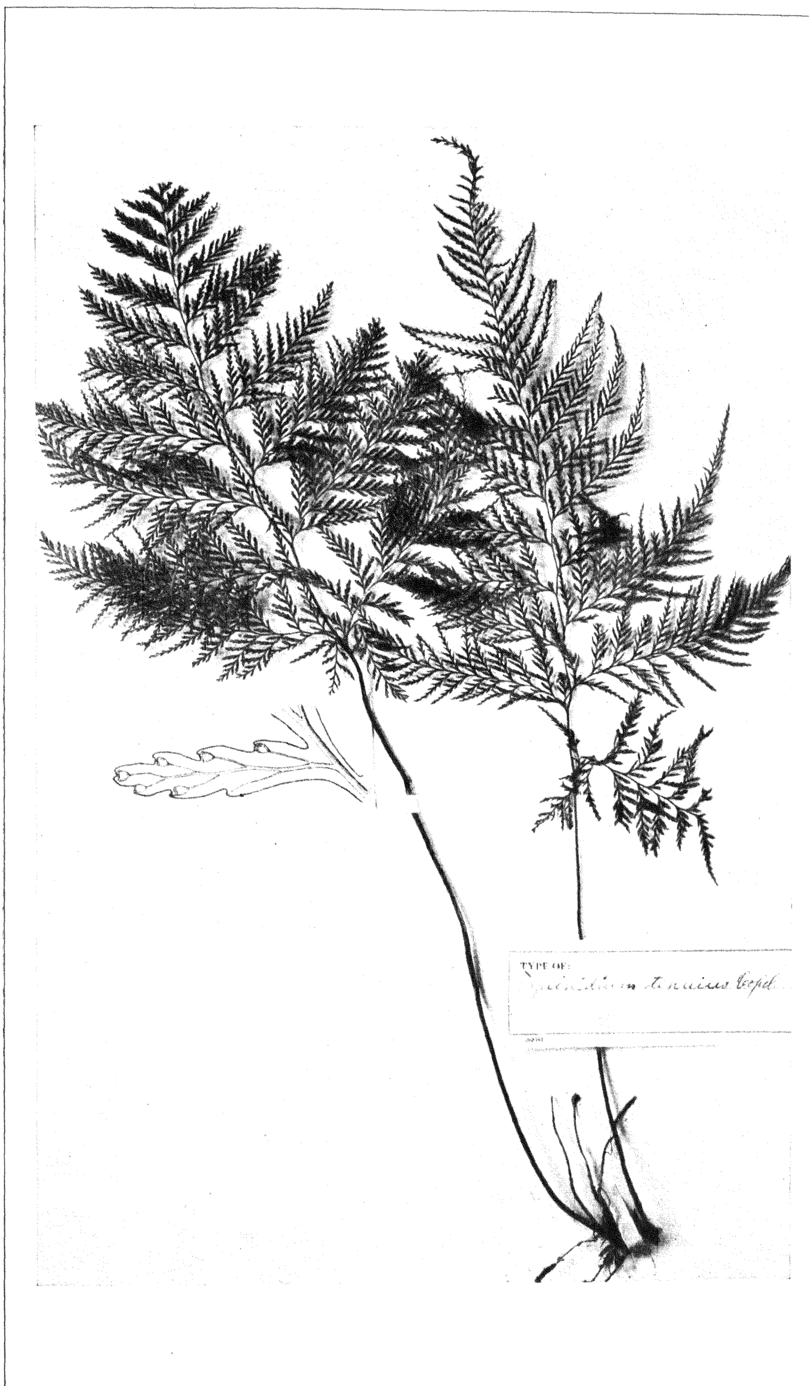

PLATE 17.

PLATE 18.

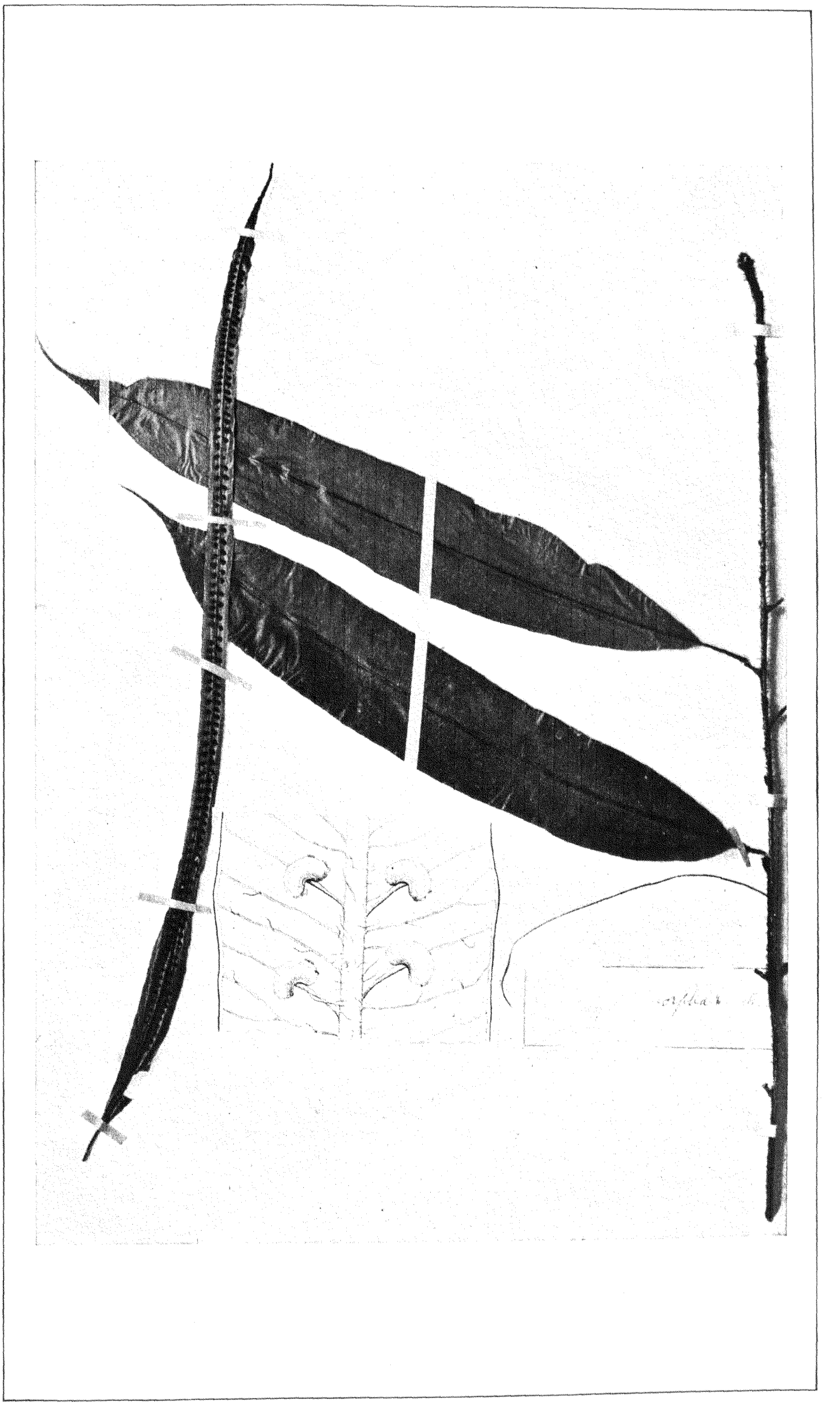

PLATE 19.

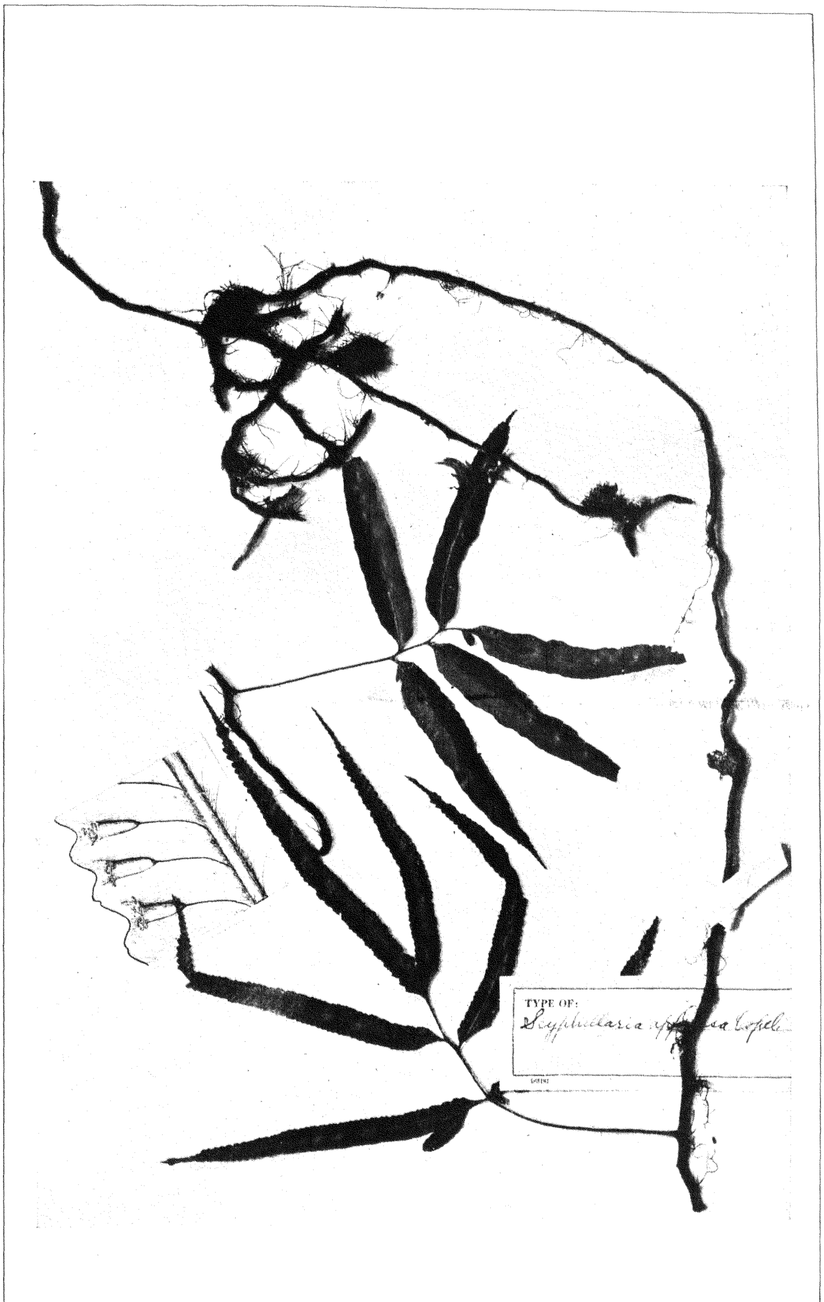

PLATE 20.

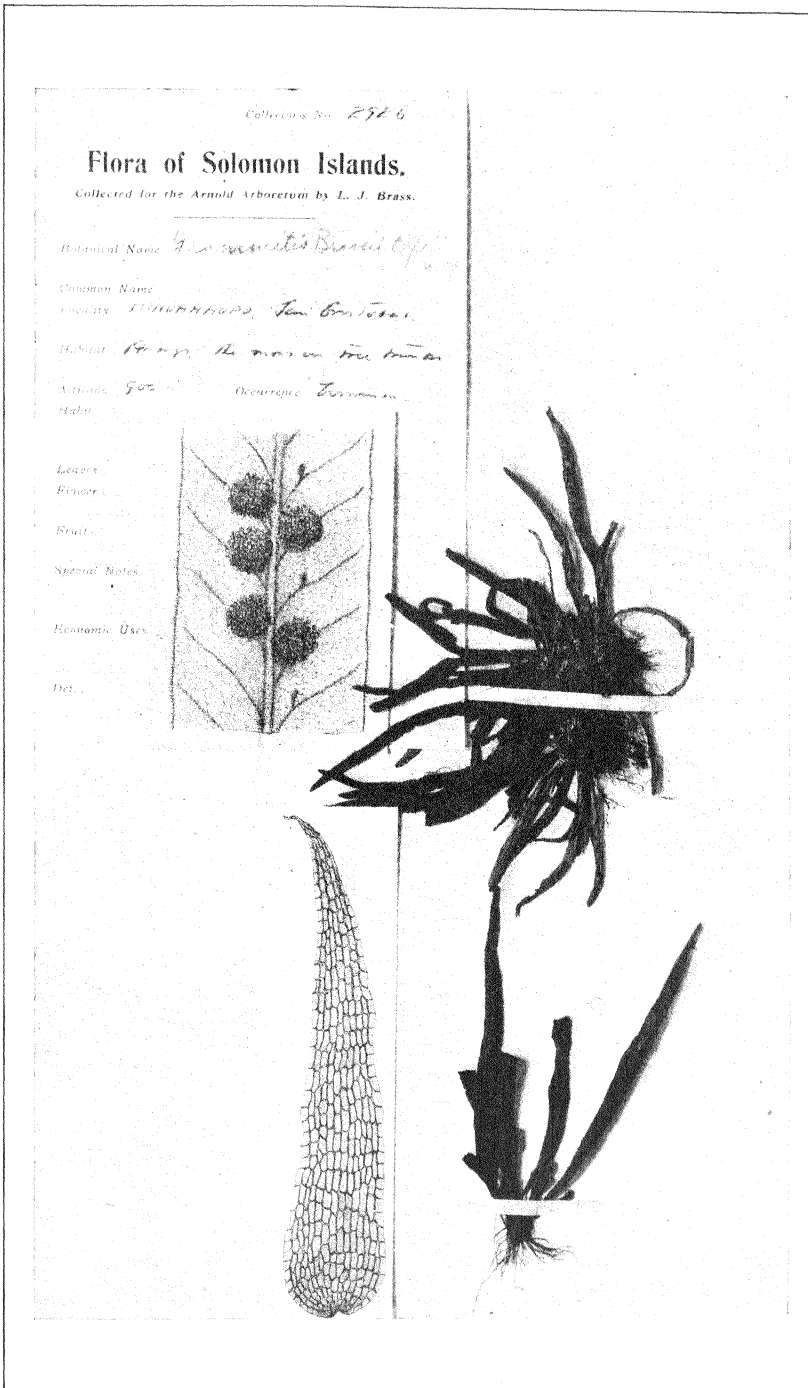
Collector's No. 2926
Flora of Solomon Islands.
Collected for the Arnold Arboretum by L. J. Brass.
Botanical Name
Common Name
Locality
Habitat
Altitude
Occurrence
Habit
Leaves
Flower
Fruit
Special Notes
Economic Uses
Det.

PLATE 21.

PLATE 22.

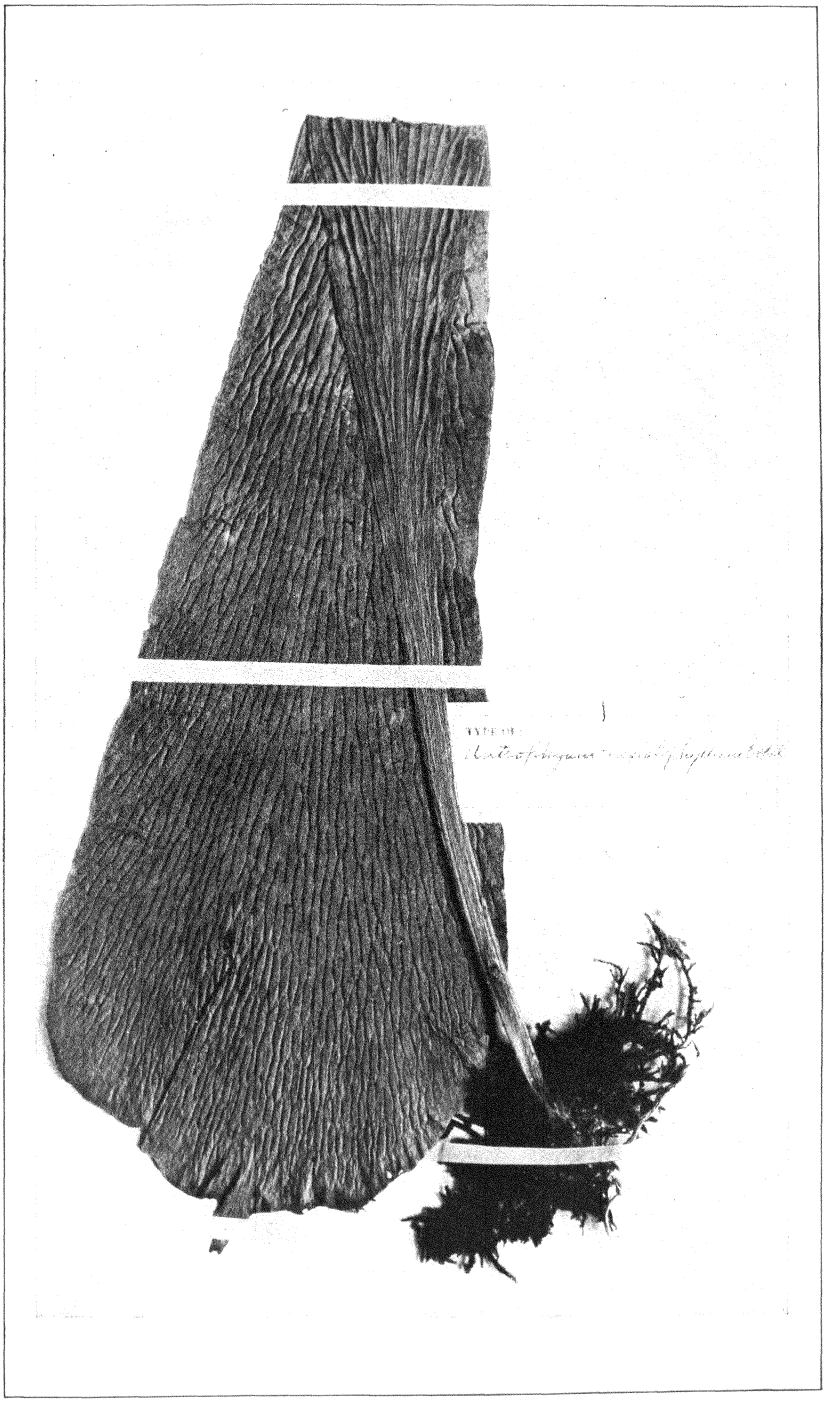

PLATE 23.

NEW OR NOTEWORTHY LOWER FUNGI OF THE PHILIPPINE ISLANDS, I[1]

By E. F. ROLDAN[2]

Of the Department of Plant Pathology, College of Agriculture, Los Baños

TWO PLATES

The present paper records seven species of lower fungi, five of which are new and two hitherto unrecorded as occurring in the Philippine Islands. These seven species of fungi herein described are from materials either collected by the writer or communicated to the Department of Plant Pathology of the College of Agriculture at Los Baños, Laguna, for determination.

The type specimens of the five new species are deposited in the Baker Herbarium of the Department of Plant Pathology of the College of Agriculture, Los Baños, Laguna, Philippine Islands.

CYLINDROCLADIUM SCOPARIUM Morg.

Cylindrocladium scoparium MORG. in Bot. Gaz. 17 (1892) 190–192.

On the petioles of *Oenothera lamarckiana* introduced into the Philippine Islands. The fungus produces blotches which are chocolate-brown, chiefly caulicolous, 5 to 10 mm in length (Plate 1, fig. 1). The hyphæ are innate or superficial, floccose. The conidiophores are borne on fertile hyphæ, dichotomously or trichotomously branched, sterigmata subternate. The conidia are hyaline, 0- or 1-septate, smooth, cylindrical, 39 to 50 by 3.5 to 5.3 μ (Plate 2, figs. 1).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 1*, April 1, 1931.

The fungus *Cylindrocladium scoparium* was described by Morgan as causing the canker of rose. This species has not hereto-

[1] Contribution No. 1124 from the Experiment Station of the College of Agriculture, Los Baños, Laguna. Read in the Third Philippine Science Convention, Manila, February 27, 1935. Published with the approval of the Dean of the College of Agriculture.

[2] The writer here records his thanks to Dr. G. O. Ocfemia, of the Department of Plant Pathology, College of Agriculture, for suggestions with regard to the preparation of this manuscript, and to Dr. Eduardo Quisumbing, of the Bureau of Science, Manila, for comments and criticisms.

fore been reported on *Oenothera* in the Philippine Islands or elsewhere.

CERCOSPORA CHRYSANTHEMI Heald and Wolf.

Cercospora chrysanthemi HEALD and WOLF in Mycologia 3 (1911) 15.

This fungus resembles very closely *Cercospora chrysanthemi* Heald and Wolf on *Chrysanthemum* sp. and is here considered identical with it.

On the host the spots are follicolar, 0.5 to 12 mm in diameter, amphigenous, irregularly circular, confluent, brownish (Plate 1, fig. 4). Conidiophore brown, simple, amphigenous, but more abundant below, fascicled, straight or subflexuous, 1- to 4-septate, 37.5 to 193.5 by 5.5 to 8 μ. Conidia hyaline, pleuroacrogenous, acicular to acicular obclavate, pleuroseptate, 6- to several-septate, 49.5 to 450 by 5 to 7 μ (Plate 2, fig. 2).

LUZON, Laguna Province, Los Baños, College of Agriculture campus, *E. F. Roldan 4,* September 10, 1933, on leaves of *Chrysanthemum coronarium* Linn.

COLLETOTRICHUM PITHECOLOBII sp. nov.

Maculis folicalis depressis, suborbicularibus, 2–6 mm diam., amphigenis pallido-flavis, sparsis v. confluentibus. Acervulis maculicolis, nigris, subamphigenis, applanatis, sparsis v. laxa gregariis, erumpentibus, parvis 60–85 μ diam.; setulis numerosis atro-fuscis, erectis, septatis nullis, apices acutis, 64–125 x 4–10.5 μ; conidiis falcatis, 14–28 x 3–7 μ intus granulosis, guttitalis.

Spots follicolar, 2 to 6 mm in diameter, depressed amphigenous, irregularly circular, pale yellow, scattered or confluent (Plate 1, fig. 3). Acervuli maculicolous amphigenous, though more abundant below, black, moderately abundant, scattered, erumpent, applanate, small, 60 to 85 μ in diameter. Setæ numerous, dark black, nonseptate, apices acute, 64 to 125 by 4 to 10.5 μ; conidia granular, falcate, hyaline, guttulate, 14 to 28 by 3 to 7 μ (Plate 2, fig. 3).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 3,* September 16, 1932, on living leaves of *Pithecolobium dulce* (Roxb.) Benth.

PHOMA ROSAENA sp. nov.

Maculis cauligenis, 2–5 mm diam. suborbicularibus, sparsis v. confluentibus. Pycnidis maculis sparsis v. laxa gregariis subglobosis, papilliformi-erumpentibus, membranaceis, brunneis, 75–240 μ diam.; estiolo 10–28 μ circ. lato; sporulis elliptico-cylindraceis, hyalinis, continuis 3.5–6 x 1.5–2.5 μ.

Spots caulicolous, 2 to 5 mm in diameter, irregularly circular, scattered or sometimes confluent (Plate 1, fig. 2). Pycnidia scattered or loosely gregarious, erumpent, subglobular, membranous, brownish, 75 to 240 μ in diameter, slightly papillate; ostiolate, 10 to 28 μ across the ostiole. Spores hyaline, elliptic to subcylindric, 35 to 5 by 1.5 to 2.5 μ (Plate 2, fig. 4).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 5,* January 26, 1931, on living stems of roses.

Other species of *Phoma* reported as upon the stems of roses are *P. rosae* Schultz and Sacc., *P. rosarum* Dur. and Mont., and *P. pusilla* Schultz et Sacc. but all of them are different from *Phoma rosaena.*

HELMINTHOSPORIUM LYCOPERSICI sp. nov.

Maculis, minutis, puntiformis, 0.25–3 mm diam., brunniis, sparsis v. coalescentibus, amphigenis; conidiophoris hypophyllis, fasciculatis, sparsis simplicibus, sub-flexeusis, olivo-brunneis, spetatis, non-constrictis 70–145 x 7–9 μ; conidiis acrogenis, clavatis, rectis v. leviter curvatis, 4- ad 12-septatis, non-constrictis, olivo-brunneis, 50–107 x 10–18 μ.

Spots small, punctiform, amphigenous, 0.25 to 3 mm in diameter, brownish, scattered or sometimes confluent (Plate 1, fig. 4). Conidiophores hypophyllous, scattered, simple, fascicled, subflexuous, olive-brown, septate, nonconstricted, 70 to 145 by 7 to 9 μ. Conidia acrogenous, clavate, straight or slightly curved, 4- to 12-septate, nonconstricted, olive-brown, 50 to 107 by 10 to 18 μ (Plate 2, fig. 5).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 2,* February 13, 1931, on living leaves of *Lycopersicum esculentum* Linn.

PHYLLOSTICTA CARTHAMI sp. nov.

Maculis primo marginalis dein amplis, confluentibus et irregularibus, subunde fere totum folium occupantibus. Pycnidiis hypophyllis, numerosis, dispersis v. gregariis in maculis, membranaceis apud mesophyll, dispositis, primo tectis deinde expositis, subglobosis, 63–133 μ diam., papillatis, ostiolatis; ostiolo 14–21 μ lato; sporolis minutis, ovideis v. ellipsoideis, 7–10 x 2–2.6 μ hyalinis.

Spots folicolous, brownish at first marginal, irregular, confluent and then extensive, sometimes involving the entire leaf. Pycnidia 63 to 133 μ broad, hypophyllous, abundant, scattered or in groups, maculicole membranous, brownish, at first located in the mesophyll then exposed subglobular, papillate, ostiolate, 14

to 21 μ across the ostiole. Conidia minute, 7 to 10 by 2 to 2.6 μ, ovate or elliptical, hyaline (Plate 2, fig. 6).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 6*, January 24, 1934, on leaves of *Carthamus tinctorius* Linn.

PESTALOZZIA HOMALOMENAE sp. nov.

Maculis suborbicularibus, angularibus, brunneis, sparsis v. confluentibus 1–2 x 2–5 mm diam.; acervulis amphigenis, punctiformibus, sparsis, subepidermidem, atris, erumpentibus in maculis 60–150 μ in diam.; conidiis elipticofusoides 14–21 μ longis 4-septatis ad septa leniter constrictis, loculis 3 interioribus, olivo-brunneis 10–14 x 5–9 μ, loculis extremis hyalines, setulis 2–3 rare 1, filiformibus brevi 6–14 μ longis, stipite brevi 5 μ longis hyalines.

Spots irregularly circular, angular, scattered or confluent, brownish, 1 to 2 by 2 to 5 mm diam.; acervuli maculicole amphigenous, punctiform, scattered, subepidermal, erumpent, black, 60 to 150 μ in diameter (Plate 1, fig. 6); spores elliptic-fusoid, 14 to 21 μ long, 4 septates with slight constriction at the point of septa, 3 middle cells olive-brown, 10 to 14 by 5 to 9 μ, exterior cells hyaline, 2 to 3 appendages, rarely 1, filiform, short, 6 to 14 μ long, stipitate, stalk short, 5 μ long, hyaline (Plate 2, fig. 7).

LUZON, Laguna Province, College of Agriculture campus, *E. F. Roldan 7*, September 10, 1934, on *Homalomena philippinensis* Engl.

ILLUSTRATIONS

PLATE 1. HOST PLANTS

PLATE 2. SPECIES OF FUNGI

PLATE 1.

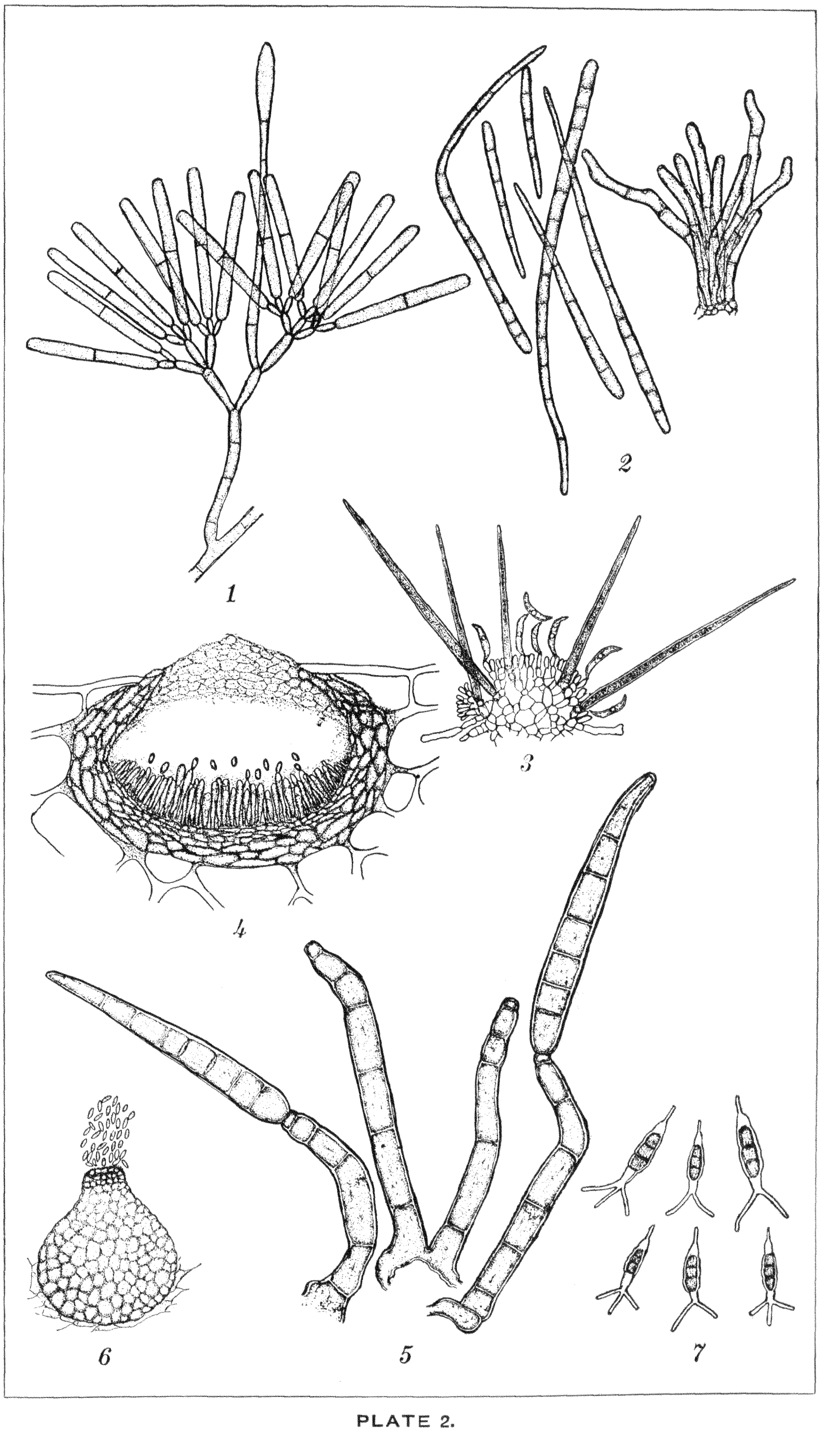

PLATE 2.

PHILIPPINE BAGASSE ASH AS A RAW MATERIAL FOR GLASS MAKING [1]

By SALVADOR DEL MUNDO
Of the Bureau of Science, Manila

TWO PLATES

The value of glass and glassware imported into the Philippines annually exceeds one million pesos. In 1934, for the period from January to August only, the imports of empty glass bottles and jars alone amounted to 359,640 pesos.[2] The life of many important industries depends on the solution of the glass-container problem. Breweries, distilleries, aërated-water factories, dairy farms, and drug stores are consumers of glass containers. A shortage in the supply of glass may seriously threaten the existence of these industries.

This paper is a preliminary report on investigations being conducted by the ceramics laboratory of the Bureau of Science to ascertain the suitability of Philippine sugar-cane bagasse ash as a raw material for the manufacture of glass.

The fibrous material obtained when sugar cane is crushed to extract the juice is commonly known as bagasse. In the Philippines baggase is regarded as a waste by-product. It is used exclusively as a boiler fuel in the power plants of sugar centrals. Since the calorific value of bagasse (about 8,300 B. T. U. per pound)[3] is relatively low, considerable quantities of this material are burned each season in the sugar-producing districts of the Philippines. During the season 1933 to 1934 about 4,466,198 long tons of sugar cane were reported as ground in seventeen sugar centrals.[4] Since about 24 per cent of the cane is bagasse and approximately 2 per cent of the material is ash, during this period about 1,072,888 tons of bagasse must have been produced which contained nearly 21,458 tons of ash.

[1] This paper was read at the general meeting of the Third Philippine Science Convention held February 28, 1935, under the auspices of the National Research Council of the Philippine Islands and the Philippine Scientific Society.

[2] Annual Report of the Insular Collector of Customs. Manila (1934).

[3] Ker, W. E., La. Exp. Sta. Bull. 117 and 160. Norris, R. S., Hawaiian Sugar Planters' Assoc. Exp. Sta. Bull. 40.

[4] Annual Reports of the Philippine Sugar Association. Manila (1930–1934).

TABLE 1.—*Quantity of sugar cane milled from 1926 to 1934 as reported by the Philippine Sugar Association.*

Year of crop.	Centrals reporting.	Gross cane ground.	Bagasse produced.	Ash.
		Tons.	*Tons.*[a]	*Tons.*[b]
1933–1934	17	4,466,198	1,071,888	21,438
1932–1933	22	5,107,776	1,225,855	24,517
1931–1932	20	4,311,760	1,034,822	20,696
1929–1930	28	5,944,727	1,426,734	28,534
1927–1928	17	4,250,591	1,020,142	20,402
1926–1927	17	4,064,698	975,528	19,510

[a] Computed on a basis of 24 per cent of gross cane ground.
[b] Computed on a basis of 2 per cent of bagasse produced.

TABLE 2.—*Analyses of bagasse.*

Constituent.	Philippine.		Formosan.
	Per cent.	*Per cent.*[a]	*Per cent.*[b]
Ash	2.11	4.73	2.40
Silica	1.86	----------	2.00
Fats and waxes	3.70	2.90	3.45
Lignin	18.90	17.49	19.95
Pentosans	25.30	22.98	24.50
Cellulose	47.01	49.86	46.00

[a] Average values of A. Valenzuela and A. P. West, Philip. Journ. Sci. **40** (1922) 279.
[b] H. Kumagawa and K. Shimomura, Zeitsch. für angewandte Chem. **36** (1923) 414.

Table 1 shows the quantity of sugar cane milled in the Philippines from 1926 to 1934 as reported by the Philippine Sugar Association. The probable production of bagasse and bagasse ash is likewise shown in Table 1. Table 2 gives a comparison of average approximate analyses of Philippine bagasse and average figures obtained for material produced in Formosa where analyses were made during a period of five years at the Giran Paper Mill of the Tainanseito Sugar Company.

Philippine bagasse ash is a friable material that is grayish to pink in color. When collected in those sections of the boiler furnace where the temperatures of combustion seldom exceed 900° C., the ash is usually grayish, owing to the presence of unburnt combustible matter. The bulk of this grayish ash consists of a powder that passes an 80-mesh screen almost completely.

The ash that accumulates in the hotter parts of the boiler furnace is known as fused ash in many sugar centrals. When this material is sifted in an 80-mesh screen, nearly 20 per cent of the ash passes through the sieve as a pinkish white powder (Plate 1, fig. 1). The residue retained on the screen consists

of pale green to faint blue clinkers and lumps. Many of these fused particles are from 0.5 to 1 centimeter in diameter (Plate 1, fig. 2). Some of them may be about the size of a chunk of coal (Plate 2, fig. 1). Fused bagasse ash is brittle and the lumps are readily crushed to a fine powder by a few turns in a steel ball mill.

The average specific gravity of bagasse-ash powder is 2.2. It is highly abrasive and people living in the neighborhood of sugar centrals employ the ash as a scouring material for household use. The only practical use that is now made of the ash in the Philippines is for filling low land and driveways. Sometimes the material is used as ballast on railroads. According to W. Scott,[5] a light paving brick can be made from bagasse ash by the use of a suitable press.

TABLE 3.—*Analyses of Philippine bagasse ash.*

Name of central.	Character of ash analyzed.	Loss on ignition	SiO_2.	Fe_2O_3.	Al_2O_3.
Pasudeco	Clinker and pinkish powder	0.1	89.1	1.3	2.8
Isabela	Grayish powder and light blue clinker	0.5	81.6	1.8	3.8
Del Carmen	Grayish powder	0.3	78.9	1.6	3.0
Paniqui Sugar Mills	Pinkish powder	0.3	80.8	1.4	2.7
Central Azucarera Tarlac	Grayish powder	0.5	79.9	1.5	2.8
Binalbagan Estate	Light green clinker, grayish powder	0.2	81.0	1.2	5.4
Calamba Sugar Estate	Fused lumps, pinkish powder	0.1	83.1	1.6	3.1
Maao Sugar Central	Grayish powder	0.5	77.5	0.8	6.2

Name of central.	Character of ash analyzed.	CaO.	MgO.	MnO.	Alkalies as K_2O.	Undetermined.
Pasudeco	Clinker and pinkish powder	2.6	1.5	0.05	2.4	0.2
Isabela	Grayish powder and light lue clinker	3.2	1.3	0.04	6.5	1.3
Del Carmen	Grayish powder	2.3	1.5	0.01	8.1	4.3
Paniqui Sugar Mills	Pinkish powder	2.2	1.6	0.14	7.8	3.1
Central Azucarera Tarlac	Grayish powder	2.3	1.4	0.05	7.4	4.2
Binalbagan Estate	Light green clinker, grayish powder	2.8	1.6	0.04	7.5	0.3
Calamba Sugar Estate	Fused lumps, pinkish powder	2.1	1.2	0.06	3.9	4.7
Maao Sugar Central	Grayish powder	2.7	2.0	0.03	7.5	2.8

In order to ascertain the average approximate composition of Philippine bagasse ash, as many samples of this material were analyzed as could be obtained from sugar centrals located in dif-

[5] Planter and Sugar Manufacturer **79** (1927) 368–381.

ferent districts of the Philippines. In Table 3 are shown the results of analyses made on material produced principally in Luzon. The figures given in Table 3 are average results of a number of analyses and therefore are about representative and typical for each locality. M. M. Alicante, of the Bureau of Science, in a study of the mineral constituents of bagasse ash in relation to juice qualities, has published analyses of material coming principally from sugar districts in the Visayan Islands.[6]

From the data given in this paper and the figures obtained by Alicante, it would seem that the average approximate composition of Philippine bagasse ash should be as shown in Table 4.

TABLE 4.—*Average mineral constituents in Philippine bagasse ash.*

Constituent.	Average analysis. Per cent.
Loss on ignition	0–1
Silica (SiO_2)	75–85
Iron oxide (Fe_2O_3)	seldom 2
Aluminum oxide (Al_2O_3)	4–8
Calcium oxide (CaO)	2–3
Magnesium oxide (MgO)	1.5–3
Manganese oxide (MnO)	less than 1
Potassium oxide (K_2O)	4–7
Phosphorus pentoxide (P_2O)	2–4

The variation in the composition of Philippine bagasse ash seems to be due more to differences in the heat of the boiler furnace than to differences in cane variety and place of origin. If the temperature of the furnace has been so high as to cause the ash to clinker and eventually fuse, the percentage of silica is somewhat higher than the average, while the percentage of alkalies which are volatile is comparatively low. According to P. de Sornay,[7] average analyses of such clinkers gave the following results:

De Sornay's average constituents of bagasse-ash clinker.

Constituent.	Per cent.
Silica (SiO_2)	88.30
Lime (CaO)	4.25
Phosphorus pentoxide (P_2O_5)	4.06
Potassium oxide (K_2O)	0.19
Undetermined	3.20
Total	100.00

When the ash has not been heated to incipient fusion, it is obtained as a coarse white powder which may be grayish or

[6] Annual Report, Res. Bur. Philip. Sugar Assoc. (1930–31).

[7] Rev. Agr. Maurice 3 (1926) 81.

pinkish in color according as it contains more or less unburnt combustible matter. This ash is usually low in silica and high in alkali. Its solubility in cold water may be as much as 2 per cent. In spite of differences in places of origin and in the variety of sugar cane from which the ash has been produced, and regardless of whether the material has been fused in the process of ashing or not, a striking uniformity may be observed in the percentages of iron oxide, alumina, lime, and magnesia of Philippine bagasse ash.

Bagasse ash is a good source of silica. The presence of this substance as a major constituent explains why the specific gravity of the ash is almost the same as that of sand. The high silica content also accounts for the abrasive properties of the ash. It might be thought that bagasse ash, being so rich in potash and phosphates, would make a good fertilizer, but it has been shown that the ashes are complex silicates formed at high temperatures and as such they are not appreciably soluble in water, so that the potash and phosphates contained in them are not available. The average solubility of Philippine bagasse ash in cold water is seldom more than 0.4 per cent. In dilute and moderately concentrated hydrochloric acid solutions, however, bagasse ash is appreciably soluble.

In view of the similarity in composition of Philippine bagasse ash and ordinary bottle glass, as may be seen from a consideration of Table 5, it occurred to the writer that a profitable way

TABLE 5.—*A comparison of the average composition of Philippine bagasse ash and different types of bottle glass.*[a]

Constituent.	Bagasse ash.	Bottle glass.[b]				
		Type 1.	Type 2.	Type 3.	Type 4.	Type 5.
Silica (SiO_2)	81.5	60.4	62.6	64.0	70.5	72.8
Aluminum oxide (Al_2O_3) + iron oxide (Fe_2O_3).	6.0	7.5	9.8	8.8	2.1	0.9
Calcium oxide (CaO) + magnesium oxide (MgO) + manganous oxide (MnO).	5.0	25.9	19.1	15.5	9.8	9.1
Sodium oxide (Na_2O) + potassium oxide (K_2O).	7.0	6.2	8.5	11.7	17.6	17.2

[a] Dralle, Die Glassfabrikation (1931) 1107.

[b] Type 1. Earliest type of bottle glass, for a long time used in France. Champagne bottles in Germany.

Type 2. Later type of German mouth-blown bottle glass.

Type 3. German Owens glass.

Type 4. American glass.

Type 5. White hollow glass and amber glass.

of disposing of this waste by-product would be to utilize it as a raw material in glass making.

Bagasse ash will rarely if ever fuse to a clear glass when heated alone, for the percentage of silica in the material is high while the lime and alkali are rather low. If these constituents of Philippine bagasse ash were adjusted to the proportions required for glass making, the silica content of the resulting mixture would still fall within the limits of glass-forming compositions.[8]

Table 5 shows that if a bottle glass high in lime should be wanted (types 1 and 2), only the lime content of Philippine bagasse ash need be corrected as the percentage of alkali would be sufficient in most cases. On the other hand, if a bottle glass high in alkali is to be made (types 4 and 5), the alkali content of the ash must be increased by additions of soda or potash. The lime content should also be slightly increased.

As a raw material for glass making, bagasse ash has certain advantages over the usual raw material, sand. This substance is chiefly composed of silica. Bagasse ash, on the other hand, contains nearly all of the other ingredients needed for glass making in addition to silica. These constituents of bagasse ash are not only present in proportions that need little modification, but they are also in intimate chemical combination.

Because of the hardness of its grains, sand is exceedingly difficult to grind to the mechanical consistency required in glass making. The grinding operation is seldom resorted to in the commercial preparation of sand for glass-making purposes. Instead, the sand is sorted and graded by flotation and sedimentation methods that are time-consuming and only practical where cheap running water is available. Bagasse ash is so loose and its particles so brittle that practically no trouble should be experienced in reducing it to any degree of subdivision to insure homogeneity in the batches and to avoid the formation of stones in the molten glass.

When sand is used as the principal raw material for the manufacture of common glass, the danger of failure from devitrification is almost always a constant menace to successful production. In order to overcome this difficulty, a common practice consists in increasing the molecular complexity of the batch by additions of kaolin or feldspathic materials that also increase the alumina content of the mixture. This procedure, however, in-

[8] Eitel, Pirani, Scheel, Glastechnische Tabellen (1932).

creases the cost of the production of glass, for these added minerals are not only expensive, but also tend to raise the melting point of the batch and to increase the viscosity of the molten glass to such an extent as to make refining difficult. Since bagasse ash is a silicate of a complex nature and has been fritted at the high temperatures of combustion in the boiler furnace, the danger of crystallization of molten mixtures containing this raw material is considerably minimized. Even if the alumina content of the ash were high, the batches made from it would still be of low melting point. These batches should not be hard to plain.

It might be supposed that the high percentage of iron in bagasse ash would exclude the possibility of making a light-colored glass from it. In most instances the glass produced is dark green. When, however, the percentage of manganese in the ash is appreciable, an emerald green glass of a pleasing color may be produced, as the violet of the manganese silicates neutralizes to a certain extent the complementary dark green due to iron.

In the course of preliminary experiments in the melting of glass batches made from bagasse ash, bottles were made which compared favorably in strength, appearance, and resistivity with the regular run of imported glass containers (Plate 2, fig. 2). Soft and medium-hard glass mixtures were included in these batches. They were melted in experimental furnaces, the largest of which consisted of an oil-fired day tank of a daily capacity of 150 kilos of glass.

A comparison of the resistance to the action of water below 100° C. of bottles made from bagasse-ash mixtures and similar imported containers is given in Table 6. The methods of Ped-

TABLE 6.—*Resistance of bottle glass made from Philippine bagasse ash to the action of water below 100° C.*

Bottle.	Milligrams of H_2SO_4 per 100 grams of glass.
Bagasse mixture 1	50.8
Bagasse mixture 2	44.5
Bagasse mixture 3	42.2
Bagasse mixture 4	38.3
Bagasse mixture 5	38.0
Milk bottle (imported)	31.3
Split bottle (imported)	23.8
Medicine bottle (imported)	66.4
Medicine bottle (imported)	47.1
Medicine bottle (made locally from "cullet" or broken scrap glass)	45.1

dle and Turner [9] were employed. Results are expressed in milligrams of sulphuric acid required to titrate the alkaline material extracted from 100 grams of pulverized glass by 100 cubic centimeters of water. The time of digestion is one hour at temperatures ranging from 80° to 100° C. The glass treated is previously reduced to a powder that passes a 20-mesh screen, but is retained on a 30-mesh sieve.

According to Peddle, glass to be useful should not show a sulphuric acid value of more than 100 milligrams per 100 grams of glass. When the sulphuric acid test gives more than 1,000 milligrams of H_2SO_4 per 100 grams of glass, the material tested may be considered useless.

Since the mechanical, thermal, and chemical properties of glass depend as much on the method of production as on the composition of the batch, it might be inferred that test figures on bottles made in small experimental furnaces and under laboratory conditions would differ from results obtained on products of actual manufacturing processes. A commercial furnace is, therefore, being constructed in this laboratory for the purpose of determining the properties of bottles made from Philippine bagasse ash.

In the Philippines there are deposits of silica (sand and sinter) suitable for glass making,[10] but their location and the excessive cost of transportation in these Islands make these deposits less desirable as a source of the prime raw material for the manufacture of glass than bagasse ash which is produced in sugar factories centrally located and readily accessible to excellent means of transportation.

The tonnage of bagasse ash produced in the Philippines yearly is so large that its disposal as a waste product is actually a problem. In the production of the ash the fuel value of bagasse is utilized, so that it will be realized that any effort to find a use for this industrial waste would meet an economic need and at the same time ameliorate the condition of the sugar industry which is actually undergoing a crisis on account of curtailed production.

[9] Trans. Opt. Soc. 23 (1921–22); Sprechsaal 55 (1922) 195; Journ. Soc. Glass Techn. 5 (1921) 195.

[10] Philip. Journ. Sci. 14 (1919) 467.

SUMMARY

The composition of Philippine bagasse ash is given in this paper. This by-product of the sugar centrals was found to contain a high percentage of silica. The other ingredients in bagasse ash were also found to be glass-making ingredients.

The following advantages may be claimed for bagasse ash as a raw material for the manufacture of glass:

1. The ash is a by-product of the sugar industry. A large tonnage of the material is available each season in sugar centrals that are readily accessible to excellent means of transportation.
2. The chemical composition of Philippine bagasse ash very closely resembles that of common mixtures for glass making. In many instances only minor corrections in the percentages of lime and alkali have to be made in the ash in order to obtain suitable glass batches.
3. The mechanical composition of bagasse ash makes it better suited as a raw material for glass making than sand, which because of the hardness of its grains is difficult to grind and grade to the proper state of subdivision required in glass making. Bagasse ash is so loose and its particles so friable that no trouble need be experienced in pulverizing the material to the required fineness. Batches from bagasse ash should therefore be more homogenous and capable of melting into a glass relatively free from stones and other defects caused by improper mixing of the raw materials.
4. Since bagasse ash is a complex silicate formed at high temperatures, there is less danger from devitrification of batches made from this material. Similar batches made from sand or siliceous sinter would, other things being equal, show a greater tendency to crystallize, unless costly ingredients are added to increase the molecular complexity of the mixtures.
5. In spite of the appreciable content of alumina in bagasse ash, batches made from this material were actually found to melt easily. No difficulty was experienced in refining glass made from Philippine bagasse ash.

We are installing a commercial furnace in the Bureau of Science for the purpose of making and testing bottles made from Philippine bagasse ash under actual manufacturing conditions.

ACKNOWLEDGMENT

To Mr. Wenceslao Trinidad, general manager of the Pampanga Sugar Development Company, obligations are acknowledged for calling our attention to bagasse ash as an industrial waste, and for a generous supply of raw material that helped in the performance of these investigations.

The author wishes to thank his assistants, Messrs. Elpidio C. Vera and Hector M. Moreno, for verifying a number of chemical analyses recorded in this paper.

ILLUSTRATIONS

1

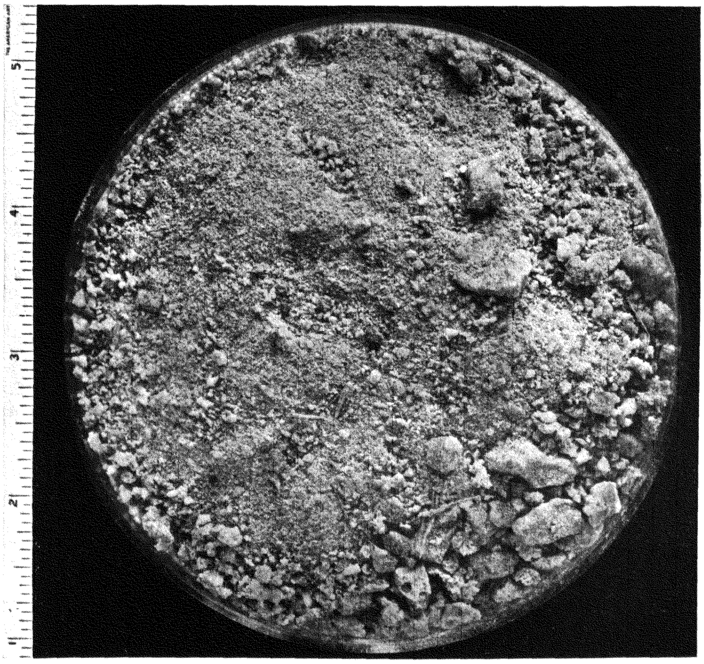

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PLATE 1.

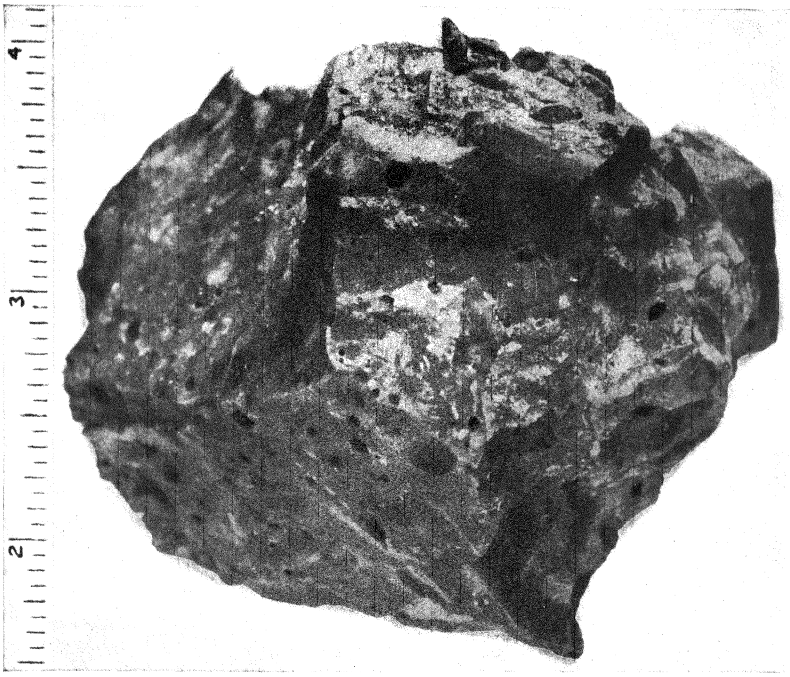

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PLATE 2.

TWO MORE SPECIES OF THE GENUS STICTODORA LOOSS, 1899, IN THE PHILIPPINES, WITH DESCRIPTION OF A NEW SPECIES

By E. Y. GARCIA and P. G. REFUERZO

Of the School of Hygiene and Public Health, University of the Philippines Manila

ONE PLATE

Since Looss erected the genus *Stictodora* for the species *S. sawakinensis* in 1899, no other member of this genus was found until Africa and Garcia (1935) described *Stictodora manilensis* from the small intestine of a Manila street dog. This genus was further enriched in the Philippines when the senior author encountered two more heterophyids with the unmistakable characters of this genus in the small intestine of dogs and several in the same organ of birds (*Larus ridibundus* Linn.) in the course of further autopsies that are being conducted on these animals in this laboratory. While one of them conforms to the description of *Stictodora sawakinensis* Looss, 1899, to which our material presumably belongs, the others present characters that seem to justify the naming of a new species. For this new *Stictodora,* the writers propose the name *Stictodora guerreroi* in honor of Prof. Luis Guerrero, head of the Department of Medicine, College of Medicine, whose keen interest in medical zoölogy and tropical medicine is well known to Philippine workers.

STICTODORA GUERREROI sp. nov. Plate 1, figs. 1 and 2.

The following description is based on the study of twenty-four adult specimens, two of which were obtained from the small intestine of a native dog, and the others from the same organ of birds (*Larus ridibundus* Linn.). They appear to be considerably smaller than *Stictodora manilensis.*

Body small, oblong, about 1.101 mm by 0.24 mm, all the reproductive organs contained in the enlarged posterior portion; cuticle spinous; œsophagus short; intestine simple tubes about as large as œsophagus in diameter, extending to posterior end of body. Ventral sucker could not be made out.

Female organs.—Ovary oval, 0.070 mm by 0.055 mm, in front of the right testis; receptaculum seminis between the testes; uterine coils fill the posterior half of body; vitellaria consist of rather small follicles arranged in transverse rows in the hind fourth of body.

Male organs.—Testes obliquely oval, placed obliquely one behind the other in the third fourth of body, posterior testis slightly larger, 0.112 mm by 0.080 mm, than anterior, 0.080 mm by 0.070 mm; vas deferens consists of three sacculations separated by short tubes located between the ovary and genital sac.

Genital sac transversely oval, 0.050 mm by 0.040 mm, preequatorial, occupied completely by the breadfruitlike protrusible gonotyl, of which the anterior two-thirds of the surface is covered by 25 to 28 circlets of simple slender spines (0.007 by 0.0018 mm), which are always perpendicular to the surface of the gonotyl. The number of spines that can be counted in each circlet in one optical plane varies from 60 to 64.

Excretory vesicle Y-shaped.

Eggs, 0.027 by 0.016 mm.

Specific diagnosis.—Body small, oblong, about 1.101 mm by 0.24 mm; intestinal cæca tubular, about as large as the œsophagus, extending to the posterior end of the body; ventral sucker invisible; testes obliquely one behind the other in the posterior part of the middle third of body; ovary anterior to right testis; seminal receptacle between the testes; uterine coils between genital sac and posterior end of body; genital sac occupied completely by a breadfruitlike gonotyl, the anterior two-thirds of which is covered by 25 to 28 circlets of minute slender spines; excretory bladder Y-shaped.

Hosts.—Native dog and *Larus ridibundus* Linn.

Location.—Small intestine.

Locality.—Biñang, Laguna Province, Luzon.

Type specimen.—Parasitological collection, Department of Parasitology, School of Hygiene and Public Health, University of the Philippines.

Remarks.—In comparing our present material with *Stictodora sawakinensis* Looss, 1899, and *Stictodora manilensis* Africa and Garcia, 1935, we find that they differ mainly in the structure of the gonotyl. In Witenberg's account the cone of the gonotyl of *S. sawakinensis* is described as having from six to ten longitudinal rows of triangular plates, and in *S. manilensis* the tip of the gonotyl bears a single circlet of large hooklets, which individually resemble the hooklets of *Tænia;* whereas in *Stictodora*

guerreroi the anterior two-thirds of the gonotyl is covered with from 25 to 28 circlets of numerous, simple, slender spines. As in *S. sawakinensis* as described by Witenberg, the ventral sucker is apparently absent, but we are inclined to believe that we have merely missed it in the present material since it has been found in *S. manilensis,* and there is evidence of its presence also in our specimen that we believe is *S. sawakinensis.*

STICTODORA SAWAKINENSIS Looss, 1899. Plate 1, fig. 3.

A lone specimen, which show characters of *Stictodora,* was recovered from the small intestine of a Manila street dog. A comparative study of this specimen with *S. sawakinensis,* which it resembles closely, revealed a minor difference between the two, the specific validity of which may be open to serious doubt, because after all it may be due to the manner of preservation. In *S. sawakinensis* the points of the triangular plates, as shown by Witenberg's text figure, are directed backwards or towards the base of the gonotyl, whereas in our material the tips of these plates are anteriorly directed, converging towards the tip of the gonotyl. Although the rudimentary sucker is present in the present material, just as it is in *S. manilensis,* we can hardly consider it a specific character, because it may be demonstrated in *S. sawakinensis.* For this reason, we refer our material provisionally to *Stictodora sawakinensis.*

SUMMARY

Two heterophyid flukes of the genus *Stictodora* from the small intestine of the dog and birds (*Larus ridibundus* Linn.), hitherto unknown in the Philippine parasitic fauna, are reported in this paper. One of these trematodes is new to science and is named *Stictodora guerreroi.* The other closely resembles *S. sawakinensis* and is provisionally referred to that species.

ACKNOWLEDGMENT

The writers are deeply grateful to Dr. Candido M. Africa, head of the Department of Parasitology, School of Hygiene and Public Health, University of the Philippines, for his suggestion to catch birds (*Larus ridibundus* Linn.) from which most of our specimens came, and for his patience in reading the manuscript.

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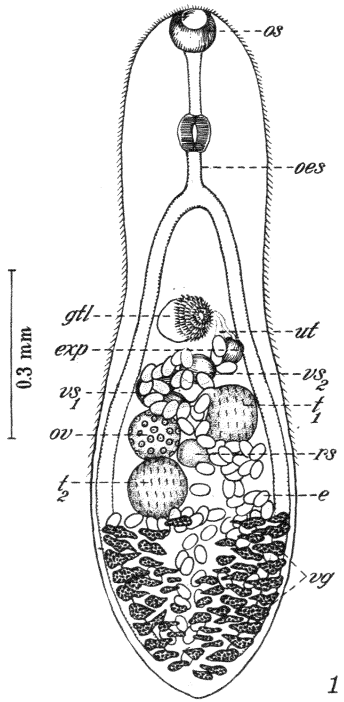
ILLUSTRATION

PLATE 1

[Abbreviations: *exp*, Expulsor; *e*, egg; *gtl*, gonotyl; *oes*, œsophagus; *os*, oral sucker; *ov*, ovary; *rac*, rudimentary acetabulum; *rs*, receptaculum seminis; *t*, testis; *ut*, uterus; *vg*, vitelline glands; *vs*, seminal vesicle.]

FIG. 1. *Stictodora guerreroi* sp. nov., ventral view.
2. *Stictodora guerreroi* sp. nov., gonotyl, a close-up view.
3. *Stictodora sawakinensis* Looss, 1899, ventral view.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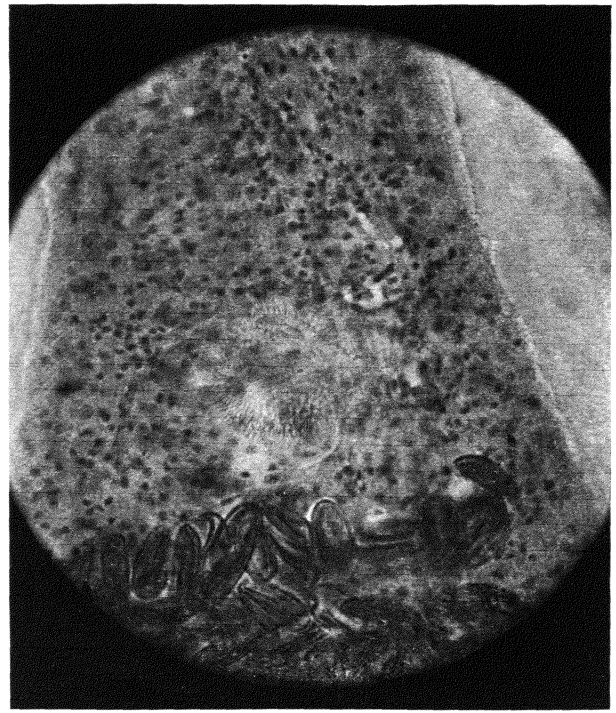

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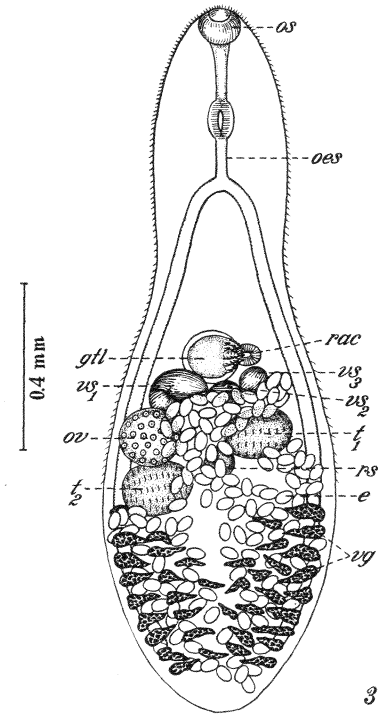
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PLATE 1.

LIFE HISTORIES OF SOME COMMON BIRDS IN THE VICINITY OF NOVALICHES, RIZAL PROVINCE LUZON, II

By Dioscoro S. Rabor

Of the Fish and Game Administration, Bureau of Science, Manila

This is a continuation of the studies on the life histories of some common Philippine birds in the vicinity of Novaliches, Rizal Province, Luzon.

The ecological conditions of the site of the present study are described in a previous paper (Rabor, 1936).

GUAVA BULBUL, PYCNONOTUS GOIAVIER GOIAVIER (SCOPOLI)

DESCRIPTION OF THE SPECIES

Adult.—The middle of the forehead and crown is seal brown, bordered on each side by a band of white which extends from the base of the bill, near the eye, to the side of the occiput, setting off clearly the black lores and ring around the eye. The general color above, including the wings and tail, is dark brown, with a fringe of olive or olive-yellow [1] to the individual feathers, clearest on the wing quills and rectrices. The ear coverts are brown; the spot below the eye, jaw, and most of the under parts, white. The individual feathers of the breast and sides have distinct brown shaft streaks giving a decidedly brownish tinge to these parts, becoming a uniform brown on the flanks and thighs. The abdomen has a pale yellow wash, becoming clearer in the posterior parts and decidedly changing to pure lemon yellow on the crissum. Likewise, the white axillars and wing linings possess a faint wash of yellow. The bill, legs, and nails are black. Five males average: Length, 198 mm; wing, 82; tail, 83; culmen, 16.5; bill from nostril, 9; tarsus, 21. Five females average: Length, 190 mm; wing, 82; tail, 85; culmen, 16.5; bill from nostril, 9; tarsus, 20.

There is no distinct sexual dimorphism in the adult of the species.

Young.—The young bird, as it leaves the nest, differs very slightly from the adult in plumage, although it is very much

[1] Contrast McGregor (1909) 516.

smaller with only a mere stub of a tail. The middle of the forehead and crown is dark brown, bordered on each side by a band of light brown extending from the base of the bill, over the eyes, to the sides of the occiput. Unopened or newly opened feathers are found on the lores and in the ring around the eye. Dorsally, including the wings and tail, the plumage is dark brown, the feathers on the back and rump being mostly decomposed. The ear coverts are brown with some feathers still unopened. In the head region the naked skin is still plainly visible owing to the deficiency of feathers, although the white of the chin and throat are already indicated by the scanty feathers on these areas. The breast, sides, and flanks are light brown, with the thighs naked except for two or three down feathers. The pale yellow of the abdomen changes to a decidedly pure lemon yellow on the crissum. The axillars and wing lining are pale yellow. The partly developed rectrices have the maximum length of 20 mm. The bill, legs, and toes are brown; the nails, flesh-colored. The white of the gape is rather distinct.

In about thirteen to fourteen weeks the young acquire the full plumage of the adult except for some scantiness in the feathering of the head. The whitish trace in the gape ultimately disappears.

DISTRIBUTION

The species is widely distributed in the Archipelago. Whitehead (1899) observed that it occurs throughout the entire group up to an altitude of 3,000 feet, "although it is one of the species that has not been met with in the Palawan group." McGregor (1909) gives the distribution as follows: Bohol, Caluya, Cebu, Guimaras, Leyte, Libagao, Luzon, Marinduque, Masbate, Mindoro, Negros, Nipa, Panay, Romblon, Samar, Tablas, Ticao, and Verde.

HAUNTS AND HABITS

The guava bulbul [*Pycnonotus goiavier goiavier* (Scopoli)] is one of the commonest of Philippine birds. It is known locally by various names, among which are "pulanga," "calaga," "luclac," "lac-lac" (Tagalog provinces); "palago" (Ticao); "curao" (Cebu); "piruca" (Ilocano provinces); and "culcul" in various provinces.

The species is very common about the bushes in open country, in second growth, and in thin forests. It is decidedly not a deep-forest form, preferring the outskirts of thick forests to the interior. The vegetation along the numerous creeks of the

vicinity under study, consisting mainly of mixed growths of bush, shrub, and tree, with their tangles of vines and creepers, provides an ideal haunt and feeding ground for the species.

Ordinarily, the birds fly about in groups of two to four, unquestionably the whole family—but never in regular flocks, although not infrequently five to a score feed in the same fruiting tree, bush, or creeper.

The feeding is always accompanied by a lot of singing, the birds giving the characteristic notes of the species as they go along with their work. The notes closely resemble the syllables "cul-cul-cul, etc.," "piruc-piruc-piruc, etc.," "luc-lac, luc-lac, etc.," given in various combinations. They seem to be restless, fluttering and chasing each other playfully from branch to branch, from tree to tree, but always within the same small radius of the food tree, unless disturbed. Not infrequently an individual is seen to cling momentarily and flutter around the flowering tip of a bush or tree branch, no doubt after the insects that feed on it. Although this bird is primarily a fruit-feeder, it is not uncommon to see individuals chasing butterflies, moths, bugs, and other insects on the wing, going to the nearest perch immediately after having caught them to devour them. Likewise, it is not rare to see the birds flying from a perch to the ground after grasshoppers and various kinds of ground insects, staying there often for as long as a minute or two, hopping now and then to locate and catch the victims, and flying to the nearest perch as soon as they have the prey secured.

The species has an unquestioned fondness for guavas (*Psidium guajava* Linn.).[2] A score or more are often seen feeding on the fruits in a small patch of this plant, clinging to them and pecking at the seeds, leaving only the fleshy pericarp attached to the tree.

The species does not fear the nearness of man; it frequents the immediate neighborhood of human habitations, including the garden where its nests are often built.

BREEDING HABITS

The species breeds from March to July, most abundantly in April and May. The latest record for the nesting of the species was June 25, when a nest with two fresh eggs was found.

The birds generally go about in groups, each group consisting of the whole family—the parents and the young of the season.

[2] Mr. Edilberto Karganilla, of the Bureau of Science, identified the plants mentioned in this paper.

The family is kept intact until the nesting season approaches, when the young separate and look for mates. There is evidence of the birds pairing for life.

A lot of chasing is done during the approach of the mating season. As the mating season progresses, the birds are seen in pairs, occasionally in groups of three, the excess bird possibly an unattached male. Ultimately a group of three birds is reduced to a pair—unquestionably the breeding couple. The male and the female feed together, from place to place, not far from the prospective nesting site. A pair that bred in the garden of the station (Bureau of Plant Industry Novaliches Mango Experiment Station) used to feed only among the plants in the garden and adjacent areas, within a radius of 100 meters from the nesting site.

Once in a while the birds of a pair chase each other as they feed, both birds flying very low. They keep on transferring from tree to tree, often going round and round in circles close to the nesting site. Apparently, the male is the pursuer. Sooner or later he catches up with the female, at which instant they close into a fluttering mass of feathers, maintaining this act until they are about to fall to the ground. All these reactions occur on the wing and are repeated frequently. The phenomenon is more pronounced and more frequent when the nest is ready for the reception of the eggs. Obviously, this is the method of copulation in the species.

The nest is typically a fairly shallow cup, moderately compact in structure with a tendency to flimsiness. The sides consist of roots and stems of grasses, weeds, and creepers, lined with fine, fiberlike, aërial roots. A layer of leaves of bamboo and other plants is invariably placed at the bottom, immediately below the inner lining. Measurements of twenty-four nests of the species were: outside diameter, 90 to 107 mm; inside diameter, 60 to 72; inside depth, 37 to 52; and outside depth, 52 to 73 mm.

The nesting sites vary a great deal but generally the species seems to prefer small or low trees, saplings, shrubs, or bushes growing in the open, in fairly thick vegetation near clearings, and in vegetative clusters of moderate thickness growing along the numerous creeks of the vicinity. Nests have never been observed in the thick part of very dense vegetative growths. Grant and Whitehead (1898), commenting on the nesting sites of the genus, wrote that the "nests are generally on the edge of the forest or in some isolated bush in old clearings." Of twenty-

four nests studied the majority were placed low (0.3 to 3 meters) in low or small trees, saplings, shrubs, bushes, or creepers growing in situations described above. Whitehead (1898) noted a nest of the species that he found in Paranas, Samar, as "cup-shaped, built of fine roots, and placed in a low tree about 5 feet from the ground in an open situation." Present observations hold his short description as typical for the nest of the species. One nest was found in a rather unlikely site, being snugly placed in the center of a cogon-grass tussock about 30 cm from the ground, supported by the stiff basal parts of the cogon leaves. The same peculiar site was noted by Hopwood (Stuart-Baker, 1932) in his observations on the nesting of the closely related subspecies, *Pycnonotus goiavier personatus* Hume, of peninsular Tenasserim and Siam, the Malay States, and Sumatra. Not infrequently the nests are situated in sites without the least attempt at concealment, so that the most casual observer cannot help but find them.

The normal clutch is two or three eggs, both numbers about equally represented in the various sets studied, although clutches of four are not rare; Steere (1888) collected such a set in Marinduque. Four of the nine sets of eggs gave two as the full complement, the remaining five nests gave three. However, two nests contained two young as the full complement and one nest had three young when discovered.

The egg is typically ovoid; a few eggs are ellipsoidal, while others are long regular ovals.

The color and markings vary a great deal. The ground color ranges from pale pink to pinkish white. In most eggs the markings consist of numerous tiny mottlings of pale red or reddish brown, scattered thickly over the whole surface, most often more numerous at the larger end, frequently forming a ring or cap on that part. In addition to these primary markings the egg has at some places underlying blotches of pale or grayish lilac. These undermarkings vary a great deal in intensity, in some being sparse, and in others so numerous as to give a purple-gray tint to the broader end. In some eggs the markings form very definite rings and caps at the broad end. The shell is fine in texture and possesses a faint gloss.

Twenty-three eggs average 20.9 by 15.8 mm; maxima, 21 by 16.5 and 16 by 23 mm; minimum, 20 by 15 mm. An egg, also from Novaliches, Rizal, in the collection of the Bureau of Science, measures 24 by 15 mm and is an exceptionally long oval.

Incubation takes thirteen days. The bird sits very close and does not flush from the nest unless approached dangerously near.

Both sexes have been shot in the nest; evidently, the male and female share in the duties of incubation. The young leave the nest in twelve to fourteen days.

The newly hatched nestlings are tiny, naked, and helpless, with the eyes still closed. The reddish skin is very transparent, and the internal organs are visible in the abdominal region. The whole period that the young stay in the nest is characterized by fast and continuous growth; however, even when they leave the nest they have not yet attained the full size of the species.

Indications of feathers can be found in the wings and some parts of the dorsal pterylæ as early as the fourth day after hatching. At about this time the eyes open, but are very tiny apertures. The young present a very bristly appearance at about the sixth day. The complete plumage develops by the eleventh or twelfth day, after which time the young are able to leave the nest and search for food with the parents.

Both sexes brood the young. During the first five days after hatching the parents do not leave the nestlings, unless forced to do so by intruders. At least one of the parents stays in the immediate vicinity of the nest, perhaps to keep up the brooding of the young. At this stage the parent birds are seemingly unafraid of human intrusion. They usually stay near by, not necessarily within sight but always within hearing, as one can easily hear them keeping up an incessant protesting murmur among the foliage of the nest plant or very near it.

The parents leave the nest oftener when the young ones have already their partial coats of feathers, although one of them is always near by, perhaps to give warning to the young at the approach of danger. In several instances, the young ones were observed lying low and motionless in the nests, while one unseen bird (apparently one of the parents) kept up an incessant murmuring protest in the neighborhood. When about to be handled or when touched they seemed to shrink still closer to the nest bottom.

The nestlings of the species, like other nestlings, are voracious feeders. The parents keep up an incessant search for food in order to satisfy their never-ending hunger. A couple with two 6-day-old nestlings was observed to get caterpillars from a "sinigüelas" (*Spondias purpurea* Linn.), at an average of one in five minutes. This was kept up for about an hour, after which time both birds came to the tree and fed on the

caterpillars themselves. They fed and played for about fifteen minutes, and then went to the nest with caterpillars in the bill. Immediately after, the birds resumed their work. Another nesting couple was observed to come for the fruits of a creeper at an average of one visit in three minutes. At times the parents went together, then, by turns.

The young birds upon leaving the nest go with the parents to feed. The nearest fruiting tree is generally chosen. Both parents then proceed to feed the young, who seem to wait for this parental help, without in any way trying to peck at the fruits themselves. Perhaps they have not yet learned to peck at the fruits. The young birds keep on making the helpless begging note.

A feeding family, if approached, offers an interesting study of avian parental care and behavior. The parents upon seeing the intruder immediately fly to the nearest neighboring bush or tree, at the same time keeping up the warning cries. They are restless as long as they see the intruder near the young. They keep hopping from limb to limb, fluttering now and then, round and round the cover, but not leaving it unless sure they are being followed. Upon sensing that the intruder keeps following them, they immediately flutter to another cover, still farther from the young. They keep this up until they succeed in leading the intruder away from the young ones.

The young ones in turn, upon sensing that danger is near, keep silent and remain motionless. If surprised on a naked perch, they maintain the same rigid position, but transfer to more leafy parts as soon as they are sure that they are not watched. Here they stay as long as the parents continue the warning calls. If the observer effectively conceals himself from the parents, the warning notes cease. Soon afterwards the young will hop about and resume the characteristic begging call for food. The parents come to them right away, and the process of feeding is resumed. When either of the parents discovers the trick, they leave again. The young have the same characteristic protective reactions as previously observed.

Young birds of the season, about seven weeks old, with only a trace of white in the gape, were observed being fed by the parents once in a while in addition to feeding themselves.

The species, in spite of all the seemingly conscious protective reactions, suffers a great deal from predators, chief among which are the traditional bird enemies; namely, the monitor lizard [*Varanus salvator* (Laurenti)], the crow (*Corvus philippinus* Bona-

parte), and the civet cat (*Paradoxurus philippinensis* Jourdan). The apparent carelessness in placing the nest in very accessible places is mainly responsible for the heavy mortality of the species due to natural enemies. Of twelve sets studied, representing both eggs and young, only six sets, or 50 per cent, were successfully reared to the time of voluntary flight from the nest. Three of the six unsuccessful sets were destroyed when still unhatched, and the remaining three as nestlings. In one peculiar case two nestlings were destroyed by a house dog, as the nest, carelessly placed low in a small jack tree [*Artocarpus integra* (Thunb.) Merr.] in a garden, was within its reach. While it is true that too few sets have been studied to warrant conclusive figures, the very low percentage of successful rearing of nestlings from them is an index to the probable rate of mortality suffered by the species.

GOLDEN-HEADED CISTICOLA, CISTICOLA EXILIS RUSTICA WALLACE

DESCRIPTION OF THE SPECIES

Adult.—There is a well-marked sex dimorphism in the adult of the species, which becomes more pronounced during the breeding season.

The male in breeding plumage has the crown of the head uniform golden buff, becoming a little dingy towards the nape and hind neck. The lores and feathers around the eye are buff, becoming whitish on the ear coverts. The cheek to the side of the neck is golden, ranging to reddish buff. The general color above is ashy gray with broad blackish streaks to the feathers of the mantle and a wash of deep tawny on the lower back, rump, and upper tail coverts. Below, including the thighs and crissum, the plumage is heavily washed with tawny or reddish buff, deepest on the breast, sides, and flanks and lightest on the middle of the breast. The primaries and outer secondaries are light brown, becoming blackish brown on the inner secondaries. All the wing feathers are more or less edged with ashy or ashy fulvous, more distinct in the inner secondaries. The rectrices are blackish with deep buff tips.

The iris is light brown; the legs, feet, and nails flesh-colored. The bill has the upper mandible dark brown and the lower mandible flesh to pinkish brown. The male assumes this type of plumage from May to August.

The female differs from the male in having broad black streaks to the fulvous-brown feathers of the head, this fulvous-brown color extending to the nape, and to hind neck with an ashy shade.

The upper tail coverts are likewise fulvous-brown; in other respects, the female closely resembles the male. The female possesses a fixed type of plumage throughout the year.

The male in nonbreeding plumage closely resembles the female in having the crown feathers streaked with black, with the underparts mostly white. The male assumes this type of plumage during the other months of the year.

McGregor (1909), quoting Bourns and Worcester, gave as the average measurements for three males, "Length, 90 mm; wing, 40.6; tail, 35.5; culmen, 11.6; tarsus, 17; middle toe with claw, 14. Two females, length, 97; wing, 40; tail, 36.5; culmen, 12; tarsus, 18; middle toe with claw, 15."

Young.—The young bird just flown from the nest is very similar to the female in plumage, except that it has a tendency to be a little browner and its underparts are washed with pale yellow, clearest on the face, throat, and breast.

The iris is the same as in the adult but the bill, legs, feet, and nails are a little bit paler than the corresponding colors in the adult. The whitish gape is rather distinct.

DISTRIBUTION

The species is found in most of the islands of the Archipelago. Whitehead (1899) observed that it was "more common and more widely distributed over the Philippines" than its congener, *Cisticola juncidis mcgregori* Hachisuka.

McGregor gives the distribution as follows: Bantayan, Bohol, Calamianes, Caluya, Cebu, Leyte, Lubang, Luzon, Marinduque, Masbate, Mindanao, Mindoro, Negros, Panay, Romblon, Samar, Semirara, Sibay, Sibuyan, Siquijor, Sulu, Tablas, and Ticao.

HAUNTS AND HABITS

The golden-headed cisticola (*Cisticola exilis rustica* Wallace), known locally as "pipit-cogon" (Tagalog) or "pirot" (Visayan), is common in wide stretches of grassland, notably deep grass such as cogon [*Imperata cylindrica* (L.) Beauv.] and talahib (*Saccharum spontaneum* Linn.) Whitehead (1899) observed that "in Luzon it is plentiful on the lalang grass-covered hills." The wide open tracts of high grass in the vicinity under study provide an ideal haunt and breeding site for the species.

The bird is not shy, even allowing one to approach to within 2 or 3 meters, while it keeps on its warblings unconcernedly from a perch which may be a high grass stem, a bush, a shrub, or a low tree growing in the open, or even high on the naked

top of a bamboo bordering a grassy tract. When disturbed it flies jerkily straight into the air, then proceeds strongly and well for about 25 meters or a little farther before it hurls itself headlong into the grass, immediately disappearing among the stems to resume its search for insect food.

The note closely approaches the syllables "tweek-tweek-churr-r," repeated after distinct intervals, the last syllable very closely resembling the note of a big katydid (*Pseudophyllus* sp.). An observer may be listening to the notes of one without being able to ascertain exactly just where the small singer is, although it may be perching rather conspicuously near by. It has the ability to throw its voice so the note will seem to come from an entirely different direction.

BREEDING HABITS

The species apparently breeds in May, June, July, and August among the more or less open tracts of deep grass in Novaliches and vicinity. The character of the nesting site makes it difficult to discover the nest. In many instances couples were flushed from possible nesting sites and were observed to behave in a way characteristic of nesting. Couples were flushed from certain definite sites, day after day, and at different hours of the day, and whenever they were disturbed, they were wont to exhibit a considerable degree of hesitancy and loathing to leave these particular sites. An observer would not hesitate to ascribe these reactions to nesting, yet careful search for the nest in these places failed to reveal it.

Couples were commonly observed chasing each other among the high grass, sometimes flying jerkily over them for short distances before settling into the thick growth where they would disappear. These couples were observed repeating from time to time the same chasing reactions. The male seemed to initiate the activity each time. Apparently the reaction is part of mating. Whether or not copulation took place at the end of each chase I could not ascertain. It should be noted, however, that sounds characteristic of struggling among the grass stems were always heard in those spots where the chasing couples disappeared. In one instance two birds chased each other straight into the air up to a great height, both individuals flying erratically and aimlessly. Now and then the female made sharp turns; now, sharp angles; then flew straight and still higher. The female seemingly made her course purposely erratic in order to avoid being overtaken by the male. Three times the male

overtook her, and each time both birds suddenly merged into one fluttering mass falling a few meters below the previous height, only to separate, rise, and continue to chase each other. Ultimately both birds hurled themselves into a cogon patch about 100 meters away. Copulation must have been accomplished every time the couple closed.

A nest with one fresh egg was found by sheer accident June 3. While I was traversing an open slope, in which cogon, sambong [*Blumea balsamifera* (Linn.) DC.], and tamo [*Curcuma zedoaria* (Berg.) Rosc.] grew profusely, a bird suddenly whirred from under me and perched on top of a bush about 5 meters away. It immediately commenced to sing. It was a female golden-headed cisticola. I looked down and hardly a foot away I saw its beautiful nest. One more step and I would very likely have destroyed it!

The nest was so cleverly placed among the cogon, tamo, and sambong that from just a meter away it was inconspicuous.

The egg-shaped nest, placed 0.3 meter from the ground, was made of cogon leaves, cleverly intertwined and woven together to form a rather semicompact structure. Through the oval opening, which was situated on the upper two-thirds of one side, could be seen the thick cozy lining of downy, white cogon fruits, which extended to the dome. The grass leaves were bound together with spider webs and cocoon threads, materials that also attached the nest partly to the stem of a small sambong plant and partly to a few cogon leaves of a near by clump. Living leaves of the sambong were cleverly pasted and held in place by spider webs and cocoon threads at the back and over the entrance of the nest, rendering it very inconspicuous from all angles.

The moderately spotted and speckled eggs were short ovals with one end rather slightly more pointed than the other. The ground color was pale blue, although in the very fresh egg a very faint tinge of green could be detected. The chocolate-brown spots and speckles, rather sparse, had a tendency to be a little denser on the broad end. The shell was moderately fine in texture and possessed a faint gloss. The eggs closely resemble the Formosan specimens described by Oates and Reid (1905).

The full complement was three, the eggs being laid at intervals of about twenty-four hours. The three eggs measured 15.0 by 11.2 mm; 15.5 by 11.0; and 15.7 by 11.5.

I flushed the female from the nest every time I visited it for observation. She had the habit of perching on top of a small tree about 20 meters away, and from there gave forth her protesting notes.

In the present study incubation took twelve days. Whether or not the male took part in incubation I could not ascertain as I never had a chance of seeing him near by, although, very likely, he might have been staying among the deep grass all the time. The female usually flushed when I was about 5 to 7 meters away and usually covered by one side of the slope. Apparently she is shy and not a very close sitter.

The newly hatched nestlings were naked and very tiny. As early as the second day, darkening of the pterylar tracts had already begun. On the fourth day the nestlings presented a bristly sight with the partly opened and unopened feathers sticking out. About the tenth day the plumage, except that of some underparts, was more or less complete.

The young left the nest in twelve days. I could not find any trace of them in the same site or near it, immediately after they left the nest, although adult birds were rather a common sight on the grassy field opposite.

SUMMARY AND CONCLUSIONS

1. The life histories of the guava bulbul, *Pycnonotus goiavier goiavier* (Scopoli) and golden-headed cisticola, *Cisticola exilis rustica* Wallace, were studied in the vicinity of Novaliches, Rizal Province, Luzon.

2. The guava bulbul, widely distributed throughout the Archipelago, is common about the bushes in open country, in second growth, and in thin forests, and in the vicinity of thick forests prefers the outskirts to the interior. The birds ordinarily fly about in groups of two to four (apparently the whole family), during the nonbreeding months; they go about in pairs during the mating season. They do not fear the nearness of man, being fond of feeding in his garden and even nesting there.

3. The breeding season of the species is from March to July, reaching its height in April and May.

4. Apparently the same birds pair throughout life until one parent is gone, in which case the remaining bird pairs with some unattached individual of the same feeding group.

5. Copulation takes place on the wing, while both birds are flying low.

6. The nest, typically a fairly shallow cup moderately compact in structure with a tendency to flimsiness, has sides of roots and stems of grasses, weeds, and creepers, and is generally lined with a layer of fine fiberlike aërial roots.

7. The nests are usually placed low (0.3 to 3 meters) on small or low trees, saplings, shrubs, or bushes growing in the open or in the outskirts of thick vegetative patches commonly bordering creeks. Not infrequently nests are placed in conspicuous places, without the least attempt at concealment, resulting in a rather high mortality of the young.

8. The typically ovate eggs, usually two or three in a clutch, have a pale pink to pinkish white ground color, heavily mottled with numerous tiny spots of pale red or reddish brown and underlain at some places with blotches of pale gray or grayish lilac. The shell, fine in texture, possesses a faint gloss. Twenty-three eggs average 20.9 by 15.8 mm.

9. Incubation takes thirteen days, with both parents participating.

10. The young leave the nest in twelve to fourteen days, with both parents brooding and taking care of them.

11. The parents continue to take care of the young until they have attained all adult characteristics except the gape, which has still the whitish trace characteristic of juvenile individuals.

12. The golden-headed cisticola, found in most of the islands of the Archipelago, is common in the wide stretches of deep grass, such as cogon [*Imperata cylindrica* (Linn.) Beauv.] and talahib (*Saccharum spontaneum* Linn.).

13. The species breeds in May to August in patches of deep grass, making the nest difficult to locate.

14. One nest was an egg-shaped structure of cogon leaves with a lining of cogon downy fruits. It was placed low (0.3 meter) among the cogon, sambong [*Blumea balsamifera* (Linn.) DC.] and tamo [*Curcuma zedoaria* (Berg.) Rosc.] that grew profusely in the site. It was attached to the sambong and cogon by spider webs, the leaves of the former effectively concealing it.

15. The eggs, three in the clutch, were short ovals with a ground color of pale blue faintly tinged with green and sparsely mottled and speckled with chocolate brown. The shell, moderately fine in texture, possessed a faint gloss.

16. Incubation took twelve days. The female, rather a shy sitter, was always flushed from the nest.

17. The young left the nest in twelve days.

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A REVIEW OF PHILIPPINE PIGEONS, III
SUBFAMILY TRERONINÆ

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The nature of this paper is similar to that of the preceding numbers of this series.[1]

The difficulty of dividing the pigeons into definable groups has been experienced by systematists that have had occasion to study them. This is evidenced by the several schemes for the classification of the smaller groups. Obviously, the homogeneity of the group causes the trouble.

The Treroninæ, like other Columbidæ, has been variously divided, and the number of genera composing this subfamily differs with the systematists. Available material and literature tend to show, however, that this subfamily consists of sexually dimorphic, arboreal, thick-billed green pigeons whose wings have yellow bands, the third primary deeply scalloped in the middle of its inner web, the rectrices fourteen, and the under tail coverts nearly reaching the tip of the tail.

A résumé of the Philippine genera previously considered under the subfamily Treroninæ will show, as in other divisions of the pigeons, the confusion arising in the formation of a distinctly natural group.

Bonaparte (1854) indicated that under the subfamily Treroninæ are the genera *Sphenurus, Treron, Osmotreron,* and others, all with fourteen tail feathers.

Salvadori (1891) reviewed the literature on pigeons published prior to his time. In his scheme he included in the Treroninæ pigeons with rather thick bill, plumage mostly green and generally with a yellow band on the wing. The genus *Phapitreron* fits this only with regard to its bill. With other genera, *Sphenocercus, Osmotreron, Treron,* and *Phapitreron* were named by Salvadori in the subfamily Treroninæ.

[1] Philip. Journ. Sci. 59 (1936) 289–305 and 327–336.

McGregor (1909) used the third primary, which is scooped on the middle of its inner web, as a diagnosis for the subfamily Treroninæ, but excepted *Phapitreron* in that regard.

Oberholser (1912) showed evidence of the priority of *Dendrophassa,* 1842, to *Osmotreron,* 1854, and believed there is no reason for rejecting the former name.

Stuart Baker (1913) in treating the doves and pigeons of India listed *Osmotreron, Treron,* and *Sphenocercus* under the subfamily Treroninæ.

Hartert and Goodson (1918) united *Osmotreron, Vinago,* and *Treron,* contending that "the extent of the naked cere or base of bill is merely a specific character." They remarked "that *Osmotreron* cannot possibly be separated from *Treron,* or else *Dendrophassa* would have to be the name, antedating *Osmotreron* by twelve years."

Hartert (1927) explained the possibility of systematists even considering *curvirostra* (species of *Treron*) and *pompadora* (species of *Osmotreron*) of subspecific rank on the basis of the bare "cere" which ranges from a short to a long one. He added that "the generic separation of *Treron* and *Osmotreron* cannot, however, be possibly admitted."

Stuart Baker (1928) in preparing the fauna of British India listed *Dendrophassa, Treron,* and *Sphenocercus* with two other genera under the subfamily Treroninæ.

Using the length of the under tail coverts that reach well beyond their toes and their generally small size, Hachisuka (1932) classified *Sphenurus, Treron, Phapitreron, Leucotreron, Neoleucotreron, Ptilinopus,* and *Haemataena* under the subfamily Treroninæ. *Osmotreron* was lumped with *Treron.*

Chasen (1935), in naming the Malaysian birds, retained the genus *Treron,* obviously for the genera *Treron* and *Osmotreron.*

It should be understood that the arguments presented by Hartert in uniting *Osmotreron* with *Treron* are based on his studies of a sufficiently large number of specimens from many regions. The genus *Sphenurus,* except for its slightly larger size and longer tail, also closely resembles the genera *Treron* and *Osmotreron.* Thus, it may not be surprising if further studies would result in the fusion of *Sphenurus* and *Treron.* For the moment, however, the genera *Treron* and *Sphenurus* are here admitted as Philippine representatives of the subfamily Treroninæ.

Key to the genera of Philippine Treroninæ.

a^1. Tail graduated, more than 120 mm long.................................. *Sphenurus.*
a^2. Tail rounded, less than 110 mm long.. *Treron.*

Genus SPHENURUS Swainson, 1837

Hard rhamphotheca bridged from frontal feathers by a maxillary depression. Resembles certain species of *Treron* but larger, darker colored, and the tail longer and graduated.

One race is known in the Philippines.

SPHENURUS FORMOSÆ AUSTRALIS (McGregor).

Sphenocercus formosæ McGregor, Bull. Philip. Mus. 4 (1904) 9.
Sphenocercus australis McGregor, Philip. Journ. Sci. § A 2 (1907) 344–345.
Sphenurus formosæ australis Hachisuka, Contrib. Birds Philip. No. 2 (1930) 170–171.

Batan, Calayan, and Camiguin Norte.

Specimens from the three islands named above were examined.

Measurements of Sphenurus formosæ australis based on 9 males and 3 females.

	Extremes. mm.	Mean. mm.
Wing	189–203	193.1
Tail	131–144	133.3
Culmen	18– 19	18.9
Tarsus	25– 26	25.9
Middle toe with claw	34– 39	36.4

This race was first recorded by McGregor (1904) from Calayan as identical with the Formosan form. After examination of the materials from Camiguin Island which he obtained later, he came to the opinion that the Philippine specimen is different from that of Formosa to which it is closely related. McGregor (1907) named the Camiguin form *Sphenocercus australis* and remarked that the Calayan birds which he recorded as *Sphenocercus formosæ* must be referred to *S. australis*.

Hachisuka (1930) indicated the subspecific rank of this form for the first time and called it *Sphenurus formosæ australis*.

In view of the fact that *Sphenurus* Swainson (1837) antedates *Sphenocercus* Gray (1840), the former is the valid generic name. McGregor (1907) clearly indicated that "this species (referring to *S. australis*) is nearly related to *S. formosæ*." Unfortunately, no specimen from Formosa had been examined in the present study. On this account and on the authority of McGregor's statement quoted above, Hachisuka's nomenclature is, for the present, followed in this paper.

Genus TRERON Viellot, 1816

Resembling *Sphenurus* but smaller, more brightly colored and the tail rounded. In some species, the hard rhamphotheca is extended to frontal feathers.

Three species with four subspecies are recorded in the Philippines.

Key to the species of Philippine Treron.

a[1]. Hard rhamphotheca reaching feathers of forehead.............. *curvirostra.*
a[2]. Hard rhamphotheca separated from forehead by a distinct maxillary depression.
  b[1]. Larger, wing 160 mm or more, mantle of male maroon.. *pompadora.*
  b[2]. Smaller, wing 150 mm or less, mantle of male not maroon.... *vernans.*

TRERON CURVIROSTRA ERIMACRA Oberholser.

Treron nasica SHARPE, Trans. Linn. Soc. London (Zool.) 1 (1879) 346.
Treron nipalensis SALVADORI, Cat. Birds. Brit. Mus. 21 (1893) 34–37.
Treron curvirostra erimacra OBERHOLSER, Journ. Wash. Acad. Sci. 14 (1924) 297.
Treron curvirostra curvirostra HARTERT, Nov. Zool. 34 (1927) 2.

Mindoro, Palawan, and Balabac Islands.

Specimens from Palawan were examined.

Measurements of Treron curvirostra erimacra based on 12 males and 3 females.

	Extremes. mm.	Mean. mm.
Wing	132–141	135.83
Tail	85– 92	88.66
Culmen	13– 14	13.60
Tarsus	22– 23	22.66
Middle toe and claw	28– 30	28.17

The bird was first collected by Steere and named by Sharpe (1876) as *Treron nasica* because of its similarity to the Sumatran form that bears this name. Salvadori in preparing the catalogue of pigeons in the collection of the British Museum classified this as *Treron nipalensis,* but acknowledged that together with that from Malay Peninsula, Sumatra, and Borneo, this form is smaller and duller than that from Nepal and Tenasserim. Oberholser (1912) indicated that *Columba curvirostra* is the oldest name for this form and showed why *Treron curvirostra* should replace *Treron nipalensis.* In a later publication, Oberholser (1924, p. 297) named the Philippine race *T. c. erimarca.* Hartert (1927, p. 2) indicated the occurrence of "*T. c. curvirostra* (or near subspecies), and *T. pompadora axillaris* in the Philippines," the former undoubtedly meant to be *T. c.*

erimacra. Hachisuka (1930) listed *Treron nipalensis nasica* as a Philippine form. Without explanation, but perhaps impressed by Hartert's nomenclature, which must have been noted later, he (1932) used *Treron curvirostra curvirostra* for obviously the same bird. Inasmuch as a new name is required for the Philippine form and as the name introduced by Oberholser for the Philippine race has not been invalidated, that should stand unchanged.

TRERON POMPADORA AXILLARIS Bonaparte.

Treron axillaris BONAPARTE, Compt. Rend. **39** (1854) 875.
Osmotreron axillaris WALDEN, Trans. Zool. Soc. London (1877) 211.
Treron pompadora axillaris HARTERT, Nov. Zool. **34** (1927) 2.

Bantayan, Basilan, Catanduanes, Cebu, Dinagat, Guimaras, Lubang, Luzon, Masbate, Mindanao, Mindoro, Negros, Panay, Polillo, Romblon, Samar, Semirara, Sibay, Siquijor, Tablas, Tawitawi, Ticao, and Verde.

Specimens from Alabat, Basilan, Biliran, Cebu, Lubang, Mindanao, Mindoro, Negros, Panay, Polillo, Romblon, Samar, Siquijor, Tablas, Ticao, and Verde were examined.

Measurements of Treron pompadora axillaris based on 23 males and 20 females.

	Extremes. mm.	Mean. mm.
Wing	160–167	162.83
Tail	95–100	96.64
Culmen	17– 19	17.77
Tarsus	23– 24	23.82
Middle toe and claw	30– 33	31.87

The Philippine form was originally described as *Treron axillaris.* Hartert (1927) lumped all the allied forms into the species *pompadora* and designated the present race *T. p. axillaris.*

TRERON POMPADORA EVERETTI (Rothschild).

Osmotreron axillaris SALVADORI, Cat. Birds Brit. Mus. **21** (1893) 48–49.
Osmotreron everetti ROTHSCHILD, Nov. Zool. **1** (1894) 41.
Treron pompadora everetti HARTERT, Nov. Zool. **34** (1927) 2.

Bongao, Meimbun, Sibutu, and Sulu.

One specimen from Bongao was examined.

The yellow tinge of neck, chin, throat, and breast of this specimen is brighter than in the corresponding parts of *T. p. axillaris.* Wing, 160 mm; tail, 95; culmen, 17; tarsus, 22.

TRERON VERNANS VERNANS (Linnæus).

Columba viridis philippinensis BRISSON, Orn. **1** (1760) 143.
Columba vernans LINNÆUS, Mantissa Plantarum (1777) 526.

Osmotreron vernans BONAPARTE, Compt. Rend. **39** (1854) 874.
Dendrophassa vernans nesophasma OBERHOLSER, Journ. Wash. Acad. Sci. **14** (1924) 297.
Treron vernans vernans HARTERT and GOODSON, Nov. Zool. **25** (1918) 355.

Basilan, Bantayan, Bohol, Calamianes, Cebu, Guimaras, Luzon, Masbate, Mindanao, Mindoro, Negros, Palawan, Panay, Siasi, Sibay, and Siquijor.

Specimens from Bantayan, Basilan, Bohol, Bongao, Jintotolo, Luzon, Mindoro, Negros, Palawan, Siasi, and Siquijor were examined.

Measurements of Dendrophassa vernans vernans based on 24 males and 13 females.

	Extremes. mm.	Mean. mm.
Wing	145–154	148.63
Tail	92–104	97.27
Culmen	15– 17	15.91
Tarsus	21– 22	21.85
Middle toe and claw	28– 31	29.61

In this study no specimen from Mindanao has been examined, thus the validity of the race described by Oberholser from that island cannot be confirmed. It may be noted, however, that Hachisuka (1932) who, I am certain, had an opportunity to study specimens from Mindanao that are in the collection of the British Museum made *Dendrophassa vernans nesophasma* Oberholser a mere synonym of *T. vernans vernans.* It is interesting to note here that specimens from Basilan that were examined in this study do not differ at all from those of the other parts of the Archipelago. This fact strengthens the findings of Hachisuka that the birds of this species in the Philippines belong to only one race.

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NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXX [1]

By CHARLES P. ALEXANDER
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THREE PLATES

The materials considered in the present report are chiefly derived from the following sources: China, collected in Hopei Province, northern China, by Mr. Chi Ho, and sent to me for study by my long-time friend, Dr. Chi Ping; a further series of interesting species from Mount Omei, secured by the Rev. Mr. George M. Franck. Japan, collected by Messrs. Esaki, Imanishi, Okada, Tokunaga, and Yamamoto. Eastern Siberia, based on very interesting collections submitted by the Russian Academy of Sciences, through the interest of Dr. Theodore Pleske and Dr. A. von Stackelberg. A few scattered specimens from diverse sources are acknowledged in the text. The types resulting from the Ho collections are deposited in the Fan Memorial Institute of Biology, Peiping; those from eastern Siberia in the collection of the Russian Academy of Sciences, Leningrad. Except where stated to the contrary, all further types are preserved in my personal series of these flies. I express my deep thanks to all of the above-mentioned entomologists for this continued friendly interest in submitting for study these neglected flies.

I am taking this opportunity to describe a new species of *Ptychoptera* from Sumatra, collected by Mrs. M. E. Walsh.

PTYCHOPTERIDÆ

PTYCHOPTERA SUMATRENSIS sp. nov. Plate 1, fig. 1.

General coloration of head and thorax blue-black; rostrum and front reddish yellow; cephalic third of postnotal mediotergite opalescent yellow; thoracic pleura yellow, the anepisternum and sternopleurite abruptly black; halteres black, the base of stem yellow; wings grayish yellow, the costal portion brighter yellow; two narrow dark brown crossbands; abdominal tergites annulated black and yellow.

[1] Contribution from the entomological laboratory, Massachusetts State College.

Male.—Length, about 8.5 millimeters; wing, 7.5.

Female.—Length, about 10 to 11 millimeters; wing, 7.7 to 8.2.

Rostrum reddish yellow; palpi with basal segment yellow, the outer segments brownish black. Antennæ with scape and pedicel yellow, flagellum black (antennæ of male broken). Front and anterior vertex reddish, the posterior portions of head blue-black.

Pronotum and propleura honey yellow. Mesonotum with scutum and scutellum uniformly blue-black, the præscutal interspaces more uniformly black; mediotergite opalescent yellow across the basal one-third to two-fifths, the posterior portion blackened; pleurotergite polished black. Pleura honey yellow, including the dorsopleural membrane; anepisternum and sternopleurite abruptly blackened. Halteres black, the base of stem narrowly yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly but conspicuously blackened; tibiæ obscure brownish yellow, the tips very narrowly darkened; tarsi black, the basitarsi paler, especially the posterior pair. Wings (Plate 1, fig. 1) tinged with pale grayish yellow, the prearcular and costal fields brighter yellow; two narrow, nearly continuous, dark brown crossbands, the first at cord, extending from R to the bend of vein Cu_1; second band extending from stigma across the forks of the outer veins, continuous or nearly so; wing tip insensibly darkened. Macrotrichia of outer cells abundant, extending basad in center of cell R before the cord (trichia indicated in figure by stippled dots). Venation: Rs short to very short; basal section of R_5 present or lacking.

Abdominal tergites annulated black and yellow, the bases of the segments beyond the second yellow, the apices broadly black, increasing in amount outwardly, the subterminal segments almost uniformly blackened; second tergite blackened at either end, yellow on central portion; basal tergite black, yellow at extreme base; sternites and genital segments of both sexes orange-yellow.

Habitat.—Sumatra (south).

Holotype, male, Pagar Alam, Palembang, altitude 2,250 feet, May 23, 1935 (*Walsh*). Allotopotype, female. Paratopotypes, 2 females.

The nearest described relatives of the present fly are *Ptychoptera annandalei* Brunetti (Burma) and *P. formosensis* Alexander (Formosa), both of which have the scutellum reddish yellow and the pleura pale yellow, unmarked. The hypopygial details are quite distinct in all three species. I have

recorded [2] an undetermined species of *Ptychoptera* as occurring in western Sumatra. The present record marks the most southeasterly distribution of the family yet made known.

TIPULIDÆ

TIPULINÆ

CTENOPHORARIA

Members of the subtribe Ctenophoraria are abundantly represented in eastern Asia, a few of the species (*Pselliophora*) occurring east of Wallace's Line in Wallacea. I am providing a key to the genera but have been obliged at this time to use only male characters. Females of several of the groups are very similar in their general appearance and no adequate characters seem to be available to distinguish such critical species. It seems very probable that *Dictenidia, Ctenophora,* and *Pselliophora,* at least, will eventually be reduced to subgeneric rank under the oldest name, *Ctenophora* Meigen.

Cnemoncosis Enderlein [3] can scarcely be maintained even as a subgeneric name as distinct from *Ctenophora.* The name is based on a species, *nohirai* Matsumura (as *hilgendorfi* Enderlein), that shows in both sexes a conspicuous dilation of the posterior tibiæ. It may be noted that the nearest ally, *Ctenophora yezoana* Matsumura, does not show this dilation, and it is evident that in the case where it occurs it is a specific feature only. Moreover, there are still other species of *Ctenophora* (as *C. pilosa* Pierre and *C. tricolor* Loew) that show a comparable expansion of the posterior femora, but these undoubtedly are congeneric with *Ctenophora* and no special name has been required for their reception.

Key to the Ctenophoraria of eastern Asia.

GENERA (MALE SEX ONLY)

1. Flagellar segments with obtusely rounded lobes, the longest not three times the diameter of the segment .... 2.
   Flagellar segments beyond the first with distinct branches that are several times as long as the diameter of the segment.......... 3.
2. Flagellar segments 3 to 13 each with two obtuse semiovate lobes, the more basal one slightly larger, about two and one-half times the diameter of the segment, the outer lobe a little shorter. *Plocimas* Enderlein.
   Flagellar segments 3 to 12 each with a single obtuse lobe. *Prionota* van der Wulp.

[2] Supplementa Entomologica 15 (1927) 90.
[3] Zool. Anzeig. 52 (1921) 219–220.

3. Flagellar segments each with two branches, one basal, one subapical, the former with setæ at tip; wings (except in *inæquipectinata*) with sparse macrotrichia in outer cells.................................. *Dictenidia* Brulle.
   Flagellar segments each with three or four branches; wings without macrotrichia in cells .... 4.
4. Flagellar segments each with three branches, the basal pair with scattered elongate setæ, the outer unpaired lobule shorter and without major setæ .... *Tanyptera* Latreille.
   Flagellar segments with four branches, a basal and an outer pair........ 5.
5. Flagellar branches unequal, the outer pair shorter than the basal ones. *Ctenophora* Meigen.
   Flagellar branches equal in length or virtually so...................................... 6.
6. Flagellar branches short; first flagellar segment with two short branches, one basal, the other subapical, the latter deeply bifid. *Malpighia* Enderlein.
   Flagellar branches long and slender, abundantly clothed with delicate erect setulæ; first flagellar segment with a single lobe that is pointed at apex .... *Pselliophora* Osten Sacken.

MALPIGHIA VITTATA (Meigen).

Ctenophora vittata MEIGEN, Syst. Beschreib. 6 (1830) 285.

Ctenophora amœna LOEW, Beschreib. Europ. Dipteren 2 (1871) 22–24; 3 (1873) 3 (in part).

Malpighia vittata ENDERLEIN, Zool. Jahrb., Syst. 32 (1912) 19–21, figs. C, D.

This species appears to be very wide-spread over the entire northern Palæarctic Region. The degree of variation in the structure of the male antennæ and hypopygium seems to permit the recognition of but a single valid species throughout this vast area. Moreover, it is very questionable whether *Malpighia angustipennis* (Loew), of western North America, can possibly be maintained as being more than a geographic race. The validity of *M. portschinskyi* Enderlein, described from a figure made many years ago by Portschinsky, is very questionable, and presumably can be settled only by examination of Portschinsky's type, if such still exists. Regarding the synonymy of *amœna* (Loew), as indicated above, the type specimen is a composite, the head being from a *Tanyptera atrata* (Linnæus) and glued to the body of a male *Malpighia vittata.*

The species, as it occurs in eastern Asia, may be briefly redescribed:

Antennal scape and pedicel black in both sexes. In the male the simple basal lobe of the first flagellar segment is usually bright orange, the bifid outer lobe brownish black, similar to the other flagellar branches. In the female only nine distinct antennal segments, the seventh flagellar being pointed at tip and evidently the product of fusion of five segments, its total

length less than the combined seventh and eighth antennal segments. Enderlein[4] figures the female antennæ as having thirteen distinct segments, but this condition certainly does not obtain in any material that I have seen. The flagellum of the female is orange throughout. Head and mesothorax black, variegated only by the bright yellow dorsopleural membrane and the orange pronotal scutellum. Abdominal tergites with the broad black median stripe of female continuous and of nearly equal width throughout, but in some specimens with the dorsum of the outer three or four tergites black, interrupted by yellow caudal rings; lateral tergal darkenings distinct or greatly reduced, in cases virtually lacking.

Numerous records are available from eastern Siberia and northern China, but to this date I have no record of the genus or species from Japan.

Golden Horn, Vladivostok, June 4, 1911 (*Rydzewski and Kusnetzov*); Vinogradovka, Ussuri, June 13, 1929 (*Djakonov and Filippjev*); Jakovlevka, Spassk district, June 3, 1926 (*Djakonov and Filippjev*); Maiche region, near Shkotovo, Ussuri, June 4, 1927 (*Stackelberg*); Okeanoskaja, near Vladivostok, June 25, 1926 (*Mordvilko*); Uval, Ussuri, May 12, 1913 (*Jemeljanov*); Amur River, near Kolvo, June 22 to 25, 1911 (*Soldatov*); near Permskaje, Habarovsk, June 3, 1911 (*Soldatov*); material in the Russian Academy of Sciences.

Eastern Tombs, Hopei Province, northern China, altitude 4,875 feet, June 7, 1931 (*C. Ho*); Fan Memorial Institute of Biology.

DICTENIDIA BIMACULATA (Linnæus).

Tipula bimaculata LINNÆUS, Fauna Suec. ed. 2 (1761) 433; Syst. Naturæ ed. 12 (1767) 972.

Okeanoskaja station, near Vladivostok, July 22 and August 7 to 12, 1911 (*Schavinskaya*); Russian Academy of Sciences.

I had earlier[5] recorded this European species from Kamchatka.

DICTENIDIA LUTEICOSTALIS Alexander.

Dictenidia luteicostalis ALEXANDER, Philip. Journ. Sci. 59 (1936) 228.

The type was from Szechwan, western China. A second female, Eastern Tombs, Hopei Province, northern China, altitude 4,875 feet, July 17, 1930 (*Ho*).

[4] Zool. Jahrb., Syst. 32 (1912) 19, fig. D.
[5] Arkiv för Zoologi 19 A, No. 9 (1927) 6.

This second specimen is a little larger than the type, the posterior leg being correspondingly conspicuous. The black pattern of the mesonotum is somewhat different from the type, there being three entire præscutal stripes and conspicuous blackened areas on the scutal lobes.

DICTENIDIA PICTIPENNIS PICTIPENNIS Portschinsky.

Ctenophora pictipennis PORTSCHINSKY, Horæ Soc. Ent. Rossicæ 21 (1887) 3–4, pl. 1, fig. 1.

Dictenidia fasciata semifasciata ALEXANDER, Ann. & Mag. Nat. Hist. IX 15 (1925) 392.

The type of *pictipennis* was from Vladivostok; that of *semifasciata* from various stations in Hokkaido, northern Japan. There is no doubt that the name *pictipennis* must replace *fasciata* Coquillett for the commonest species of the genus in eastern Asia; the latter name may be retained for the form or subspecies having the broad basal dark fascia completely traversing the wing without change in color.

The two forms seem to intergrade almost insensibly. A female from Iwate, Japan (July, 1916, *Nohira*) has cells Cu, 1st A, and 2d A pale. The type material of *semifasciata* has the dark color of the basal fascia restricted to cells C to R, inclusive. The Chinese specimen recorded below has this dark pattern still different, restricted to cells R and M, cells C and Sc being uniformly pale.

As now known, typical *pictipennis* has a range including northern Japan, eastern Siberia, and northern China.

Sedanka, near Vladivostok, August 10, 1913 (*Berger*); Habarovsk, Ussuri, July 28, 1927 (*Stackelberg*). Eastern Tombs, Hopei Province, northern China, altitude 4,875 feet, July 17, 1930 (*Ho*).

CTENOPHORA YEZOANA Matsumura.

Ctenophora yezoana MATSUMURA, Thousand Insects of Japan 2 (1906) 124, pl. 29, fig. 6.

Cnemoncosis uniplagiata ALEXANDER, Ann. Ent. Soc. America 17 (1924) 442.

Matsumura's original description of *yezoana* is entirely in Japanese. The type material of *uniplagiata* differs markedly from the description of *yezoana*, especially in the pattern of the thorax, and it seems evident that the sclerites of the thoracic dorsum were much confused by Matsumura. The color pattern, as shown by the types of *uniplagiata*, varies somewhat in dif-

ferent individuals but always within restricted limits that may be described as follows:

Anterior border of præscutum uniformly blackened, the yellow referred to by Matsumura evidently pertaining to the broad central yellow area of the pronotal scutellum; three distinct black or brownish black præscutal stripes, in cases with the laterals joined to the median by a dark cloud on the anterior interspace; yellow ground color of præscutum restricted to the humeral triangle and the interspaces; scutum black, usually including the median area, the broad posterior borders of the scutal lobes yellow; scutellum entirely black; mediotergite black, each antero-lateral angle broadly yellow. Pleura black, the dorsopleural membrane broadly light yellow.

Antennal scape and pedicel black dorsally, paler beneath; flagellum (female) light yellowish brown. Frontal prolongation of head and front yellow, narrowly lined medially with black; genæ protuberant, yellow. Second abdominal tergite yellow, the outer third blackened, sending a median dark line to anterior border; posterior yellow margins of succeeding segments entire or broken by a median black prolongation.

CTENOPHORA YEZOANA NIGROBASALIS subsp. nov. Plate 1, fig. 2.

Male.—Length, about 20 millimeters; wing, 15.

Female.—Length, about 20 to 25 millimeters; wing, 13 to 17.

Characters as in typical *yezoana* Matsumura, differing as follows:

Antennæ (male) black, the entire lower surface of scape yellow; in female, antennal flagellum entirely black. Surface of thorax entirely dull, not at all polished as in most species of the genus. Thoracic pleura conspicuously variegated by yellow, including major areas on the ventral pleurotergite, almost the entire pteropleurite and the dorsal sternopleurite. Fore and, in cases, middle coxæ yellow or reddish, posterior coxæ black, pruinose; posterior tibiæ black, with a broad whitish ring at and beyond midlength; in typical *yezoana* the entire basal half of this tibia is chiefly pale. Wing venation as shown (Plate 1, fig. 2). Abdominal tergites yellow, with a median black line that expands at the posterior border; basal rings of tergites narrowly blackened, the color continued caudad along the lateral border of the tergite almost to the posterior margin, inclosing sublateral areas of the ground color; eighth and ninth segments (male) uniformly black; basal sternites almost uniformly yellow, the outer seg-

ments progressively more darkened medially. In the female the yellow intersegmental membrane shows on the dorsum as transverse annuli between the tergites.

Habitat.—Eastern Siberia (Ussuri).

Holotype, male, Jakovlevka, Spassk district, June 17, 1926 (*Djakonov and Filippjev*). Allotopotype, female, July 2, 1926. Paratype, female, Golden Horn, Vladivostok, May 29, 1911 (*Rydzevski and Kusnetzov*).

The essential distinctions lie in the black antennal flagellum of female, the variegated thoracic pleura, the blackened bases of the posterior tibiæ, and the abdominal pattern.

CTENOPHORA BIGUTTATA Matsumura.

Ctenophora biguttata MATSUMURA, Thousand Insects of Japan, Add. 2 (1916) 454–455, pl. 24, fig. 16.

This fly, described from northern Japan, is now known from several stations in eastern Siberia, recorded below. The species varies very notably in the pattern of the mesonotal præscutum, in many cases, including the type, there being three entire black stripes, in other individuals with the lateral stripes partly or entirely obliterated. The brownish black to black subterminal ring of the posterior femur is conspicuous and usually entire, but in some cases obliterated on the ventral surface of the sclerite.

Jakovlevka, Spassk district, Ussuri, June 17, 1926 (*Djakonov and Filippjev*); June 25, 1927 (*Martynov*); Tigrowaja, Suchan district, June 16, 1927 (*Stackelberg*); 20 kilometers east of Spasskoje, May 11 to June 24, 1910 (*Skonninov*). All of these specimens are females.

CTENOPHORA FEMUR-RUBRA sp. nov. Plate 1, fig. 3.

Closely related to *Ctenophora biguttata* Matsumura, differing especially in certain features of coloration.

Female.—Length, 20 to 24 millimeters; wing, 17 to 18.

Frontal prolongation of head reddish throughout or (type) blackened on sides.

Mesonotal præscutum reddish, with a single median black stripe, narrowed behind and not or scarcely reaching the suture; posterior sclerites of notum uniformly reddish, with the exception of a posterior darkening on the mediotergite. In *biguttata* there are usually three distinct præscutal stripes, the centers of the scutal lobes are blackened, the scutellum is uniformly black, and the dark area on mediotergite is more extensive. Pleura reddish, the dorsopleural membrane bright yellow; anepister-

num and sternopleurite black. Legs with all coxæ, trochanters, and femora reddish, the posterior femora less swollen near tips than in *biguttata* and without the conspicuous black subterminal darkening of the latter; posterior tibiæ orange-yellow on basal half, the posterior half clearer yellow; in *biguttata,* yellowish at base, with a broad blackish ring near midlength; posterior tarsi entirely pale. Wings (Plate 1, fig. 3) with the pattern much as in *biguttata,* the anterior half darkened, the posterior cells paler; in the paratype the posterior cells are darker, not contrasting markedly with the remainder of wing. Abdomen with outer tergites more variegated laterally with yellow.

Habitat.—Saghalien; northern China.

Holotype, Manui, Saghalien, August 3, 1922 (*Esaki*).

Paratype, female, Eastern Tombs, Hopei Province, northern China, altitude 4,875 feet, June 9, 1931 (*Ho*).

I have recorded [6] the above-mentioned Saghalien material as being *Ctenophora biguttata* Matsumura. A third closely related species is *C. parva* Portschinsky (Ussuri), which differs especially in the smaller size and almost uniformly blackened head and thorax. It is possible that these three supposed species may be found to represent forms or races of a single highly variable species.

PSELLIOPHORA BIFASCIIPENNIS Brunetti.

Pselliophora bifasciipennis BRUNETTI, Rec. Indian Mus. 6 (1911) 241–242.

Pselliophora sackeni EDWARDS, Ann. & Mag. Nat. Hist. VIII 18 (1916) 257.

Dictenidia Horikawæ MATSUMURA, Thousand Insects of Japan, Add. 2 (1916) 449–450.

Pselliophora compta ENDERLEIN, Zool. Anzeig. 52 (1921) 220–221.

A male specimen, Harbin, Manchoukuo, July 1, 1909 (*Vassiljev*), in the Russian Academy of Sciences, provides the most northern known record for this genus and species.

In body coloration this specimen might well be taken to represent a distinct species, but the wing pattern and structure of the male hypopygium indicate that it pertains to this highly variable species. Head and thorax uniformly orange, without dark markings. Abdomen orange, the tergites with a narrow median dark vitta; hypopygium dark brown, the tergal lobes passing into black.

Scarcely anything is known concerning the degree of color variation in this genus. The allied *Ctenophora apicata* Osten

[6] Philip. Journ. Sci. 24 (1924) 596.

Sacken (Nearctic) has been shown to be highly polymorphic, the body coloration ranging from black to reddish yellow.[7]

TANYPTERA JOZANA UNILINEATA subsp. nov.

General coloration of mesonotum reddish, the præscutum with a single, median, polished, black stripe; antennæ (male) with flagellar segments chiefly yellow, the tips of the branches dusky; wings strongly suffused with yellow, stigma black or brownish black; abdomen, including the hypopygium, reddish, the tergites with a nearly continuous median black stripe.

Male.—Length, about 20 millimeters; wing, 15 to 17.

Female.—Length, 25 to 28 millimeters; wing, 15 to 18.

Male.—Antennæ with the scape black; pedicel and flagellum chiefly yellow, the outer ends of the branches dusky, more evident on the outer segments. Head black.

Mesonotal præscutum deep reddish, with a single median black stripe, narrowed behind and reaching the suture; posterior sclerites of mesonotum reddish, the caudal margin of mediotergite blackened; in cases (Vladivostok specimen) with the scutellum black. Pleura reddish, variegated with darker areas, the ground color more or less restricted to beneath the wing root; dorsopleural membrane yellow. Halteres yellow. Legs yellow, the outer tarsal segments black; in cases (Vladivostok specimen) with femoral tips narrowly blackened. Wings strongly suffused with yellow; stigma black or brownish black.

Abdomen reddish, the color including the hypopygium; tergites with a narrow, nearly continuous, black, median stripe, the areas a little expanded behind on the individual segments; hypopygium relatively large.

Female.—Abdomen with basal two segments reddish, the remainder black, or reddish with a black median line on tergites, the caudal borders of the segments yellow.

Habitat.—Eastern Siberia; northern China.

Holotype, male, Kamen-Rybolov, Lake Chanka, Ussuri, Siberia, May 22, 1908 (*Djukin*). Allotype, female, Reinovo, Dshalinda, Amur, July 1 to 3, 1915 (*Popoff*). Paratypes, male, Golden Horn, Vladivostok, May 28, 1911 (*Rydzewski and Kusnetzov*); male, Ulunga, Amur Province, June 3, 1910 (*Mishin*); female, Eastern Tombs, Hopei Province, northern China, altitude 4,875 feet, July 14, 1930 (*Ho*).

The reddish mesonotum, with a single median black stripe, distinguishes the present fly from typical *jozana* (Matsumura).

[7] Johannsen, O. A., Maine Agr. Exp. Sta. Bull. 177 (1910) 32–35.

TIPULARIA

TIPULA (TIPULODINA) HOPEIENSIS sp. nov. Plate 1, fig. 4; Plate 2, figs. 25 and 26.

General coloration gray, the præscutum with three brown stripes; pleura uniformly light yellow; antennæ (male) short, if bent backward not attaining the wing root; posterior tibia with two white rings; all tarsi with outer three segments darkened; wings weakly infumed, clearer white before and beyond cord; a restricted darker brown pattern at wing tip; male hypopygium with the eighth sternite only moderately sheathing; appendage of basistyle straight, with a blackened spine near tip.

Male.—Length, about 15 millimeters; wing, 14.5.

Frontal prolongation of head brown; nasus distinct; palpi brownish black, the terminal segment of moderate length only, paling to yellow. Antennæ short, if bent backward not attaining the wing root; scape and pedicel light yellow, flagellum black; flagellar segments subcylindrical, the basal enlargement very insignificant; verticils chiefly unilateral in distribution, shorter than the segments. Front light silvery gray; posterior part of head darker brownish gray, with very vague suggestions of a median darker vitta.

Pronotum brownish gray medially, yellow on sides. Mesonotal præscutum light gray, with three brown stripes, the median one divided on anterior half by a capillary darker vitta; scutum dark gray, each lobe with two brown areas; scutellum blackish, the parascutella a little paler; mediotergite brownish gray; pleurotergite yellow, the dorsal portion more grayish. Pleura, including the dorsopleural region, light yellow. Halteres brownish yellow, the knobs infuscated. Legs with the coxæ and trochanters yellow; all femora yellow, the tips narrowly but conspicuously blackened; fore tibia black, the basal fifth a trifle brightened; a relatively narrow snowy white ring before the subequal black apex; midtibia similar, the white ring a trifle more extensive than the apex; posterior tibia with two white rings, the subbasal one less clearly white than the subapical, the latter about one-third more extensive than the dark apex; basitarsi black on proximal portions; second tarsal segment dirty white, more or less darkened at either end; outer three tarsal segments darkened; legs long and slender. Wings (Plate 1, fig. 4) with the ground color weakly infumed, clearer white before and beyond the cord; cell Sc and stigma dark brown; wing tip in cells R_2 to R_5, inclusive, paler brown; cord narrowly seamed with brown, interrupted at fork of M; veins brown, paler

in the whitish areas. Venation: Rs a little shorter than R_{2+3}; second section of vein M_{1+2} arcuated, narrowing the base of cell R_5; petiole of cell M_1 shorter than m; basal section of M_3 shorter than m; cell 2d A very narrow, striplike.

Abdominal tergites brownish black, the basal three segments more brownish on sides; hypopygium black; styli and hypopygial appendages yellow. Male hypopygium (Plate 2, fig. 25) with the tergite, *9t*, separated from the sternite by membrane; basistyle, *b*, relatively large, fused with the sternite except on ventral portion, the caudal margin obtusely rounded; appendage of basistyle as figured (Plate 2, fig. 26). Ninth tergite (Plate 2, fig. 25, *9t*) transverse, the caudal-lateral angles rounded, the median region produced slightly caudad and bearing a small tuft of black setæ at lateral portions; viewed from beneath, these lateral portions are produced ventrad into flattened sclerotized plates. Outer dististyle (Plate 2, fig. 26, *od*) slender, entirely pale. Inner dististyle (Plate 2, fig. 26, *id*) of complicated structure, as figured; a highly compressed pale blade, with a powerful posterior blackened arm. Eighth sternite, *8s*, relatively short and only moderately sheathing the ninth, the apex obtuse and provided with a sparse fringe of short setæ; distal portion of sternite thinner and paler than basal portion.

Habitat.—China (Hopei).

Holotype, male, Eastern Tombs, altitude 4,875 feet, July 13, 1930 (*Ho*); Fan Memorial Institute No. 2730.

The closest relative is *Tipula* (*Tipulodina*) *nipponica* (Alexander), of Kiushiu, Japan, which differs in the larger size, gray pleura and coxæ, white outer tarsal segments, and wider cell 2d A. I have never seen a male of this latter species. The present record indicates the most northern distribution for any member of the subgenus (40° north latitude).

TIPULA (YAMATOTIPULA) PARVINCISA Alexander.

Tipula (*Tipula*) *parvincisa* ALEXANDER, Philip. Journ. Sci. 52 (1933) 311–312.

The types were from the Ussuri district, eastern Siberia, as far south as Vladivostok.

Males and females, Peiping, Hopei, China, June 18, 1930 (*Ho*).

TIPULA (OREOMYZA) PINGI sp. nov. Plate 1, fig. 5; Plate 2, fig. 27.

General coloration gray, the præscutum with four entire darker brownish gray stripes; antennæ with basal three segments yellow, the remainder black; head with a capillary brown median vitta on vertex; wings with borders chiefly darkened,

the disk and bases of anal cells whitened; outer half of cell R_5 white; abdominal tergites obscure yellow, trivittate with brownish black, the fifth and succeeding segments uniformly darkened; male hypopygium with the tergite bearing an acute median point; outer dististyle broadly spatulate.

Male.—Length, about 13 millimeters; wing, 14.

Female.—Length, about 20 millimeters; wing, 16.5.

Frontal prolongation of head light brown, moderately elongate, nasus conspicuous; palpi black. Antennæ (male) relatively short, if bent backward not attaining the wing root; basal three segments yellow, the remainder black; basal enlargements of the segments only feebly indicated; longest verticils subequal to the segments; terminal segment reduced to a small oval structure. Head light gray, the front and anterior vertex more whitish; a very delicate capillary brown vitta from the vertical tubercle to the occiput; posterior genæ suffused with dusky.

Mesonotal præscutum gray, with four darker brownish gray stripes that are unbordered with darker and not well-defined against the ground; intermediate stripes strongly narrowed behind; posterior sclerites of notum gray, without distinct markings. Pleura pale gray, the dorsopleural membrane light yellow. Halteres yellow, the knobs dark brown. Legs with the coxæ pruinose; trochanters yellow; femora yellow, the tips narrowly but conspicuously blackened; tibiæ yellowish brown, the tips narrowly darkened; tarsi brownish black; tibial spur formula 1–2–2; claws (male) with long basal tooth. Wings (Plate 1, fig. 5) with the borders chiefly darkened, the center of disk and bases of anal cells white; prearcular field and cells C and Sc uniformly darkened, the latter a little more intense; a conspicuous white poststigmal band, beginning at costa, ending in bases of cells M_3 and M_4, more or less confluent across the cord with the major pale area in cell M; distal half of cell R_5 conspicuously pale; pale areas before and beyond origin of Rs in cell R; pale area in cell M divided at near midlength by a narrow, oblique, brown vitta, the outer pale subarea a little larger; cell Cu chiefly pale on more than basal half, the distal portion darkened; cell Cu_1 and seam on m-cu narrowly dark brown; veins pale yellow in the whitish areas, darker in the brown markings. Venation: Rs nearly twice as long as m-cu; R_{1+2} entirely preserved; m-cu on M_4 just beyond base.

Abdominal tergites obscure yellow, trivittate with brownish black, on the fifth and succeeding segments becoming more uniformly blackened. Male hypopygium (Plate 2, fig. 27) with the

tergite, *9t*, entirely separated from the sternite; basistyle completely separated, its outer portion not produced caudad. Ninth tergite, *9t*, with a median dorsal depression that is further produced caudad into an acute compressed point that does not extend beyond level of the blackened, obtuse, sublateral lobes; dorsum of tergite with scattered setæ, except in the median depression. Outer dististyle, *od*, very narrow at base, the distal two-thirds dilated into a spatula. Inner dististyle, *id*, as figured; basal portion on outer margin more blackened. Gonapophyses, *g*, appearing as flattened black blades, each terminating in a ventrally directed spine, the caudal margin with a series of smaller spines. Eighth sternite, *8s*, unarmed.

Habitat.—China (Hopei).

Holotype, male, Eastern Tombs, altitude 4,875 feet, July 17, 1930 (*Ho*). Allotopotype, female, in author's collection.

I take great pleasure in naming this handsome species in honor of Dr. Chi Ping, my long-time friend and colleague. The species is quite distinct from other somewhat similar species, as *Tipula* (*Oreomyza*) *famula* Alexander, *T.* (*O.*) *futilis* Alexander, and *T.* (*O.*) *vitiosa* Alexander. Of the above, only the last has the outer portion of cell R_5 white, as in the present fly, and in all other regards is a very different species.

TIPULA (OREOMYZA) PLATYGLOSSA sp. nov. Plate 1, fig. 6; Plate 2, fig. 28.

Belongs to the *juncea* group; mesonotum chiefly dark gray; antennæ (male) long, the flagellar segments binodose; wings hyaline, the costal border and stigma pale brownish yellow; R_{1+2} entire; male hypopygium with the tergite deeply notched medially, the lateral lobes truncated and blackened at tips; outer dististyle unusually long and slender; eighth sternite with a broad shovel-shaped lobe.

Male.—Length, about 18 millimeters; wing, 17.

Frontal prolongation of head relatively short; nasus short but distinct; palpi with basal segment obscure brownish yellow, the remainder black. Antennæ with scape and pedicel yellow, flagellum black; antennæ broken at near midlength, when entire apparently about one-half as long as wing; flagellar segments elongate, incised to appear weakly binodose, the basal enlargement shorter but a little deeper than the apical portion; verticils much shorter than the segments. Front and anterior part of vertex yellow, posterior portions of head dark gray.

Mesonotal præscutum deformed in type, apparently almost uniformly blackish gray; scutal lobes similarly darkened; scutellum and central portion of mediotergite darkened, the parascutella, lateral portions of mediotergite, and the pleurotergite yellow. Pleura yellow, variegated with darker on ventral portions. Halteres elongate, pale, the knobs weakly darkened. Legs with the coxæ brownish yellow; trochanters yellow; femora brownish yellow, the bases clearer, the tips narrowly brownish black; tibiæ and tarsi passing into brownish black; vestiture of bases of femora very short and delicate. Wings (Plate 1, fig. 6) hyaline, cells C, Sc, Cu_1, and the stigma pale brownish yellow; veins brown. Macrotrichia relatively numerous on veins beyond cord; squama naked. Venation: Rs about one-half longer than m-cu; R_{1+2} entire; M_{3+4} short, subequal to basal section of M_{1+2}; cell M_4 of nearly equal width at base and apex; m-cu just beyond origin of M_4.

Abdomen with tergites chiefly yellow, weakly variegated with darker; sternites yellow. Male hypopygium (Plate 2, fig. 28) with the tergite, *9t*, separated from the sternite, *9s*, by membrane; basistyle not clearly differentiated from sternite, its caudal-dorsal angle produced caudad and slightly dorsad into a subacute sclerotized projection; caudal-ventral portion of basistyle with a small setiferous arcuate lobe, directed mesad. Ninth tergite, *9t*, with a deep V-shaped notch, the lateral lobes truncated and blackened at tips; on ventral face, on outer margin back from tip, a small blackened point, most evident when viewed from the side. Outer dististyle long and slender, as in the group; basal third slightly dilated on cephalic face. Inner dististyle, *id*, with the beak unusually slender; base of style produced into a flattened leaflike blade, the disk of which bears a few scattered setæ. Eighth sternite, *8s*, bearing a broad, liguliform lobe, its apex truncated; along either lateral border with a dense brush of delicate setæ, these longer and covering the entire surface at and near apex of lobe.

Habitat.—Siberia.

Holotype, male, Tunkun, Sajan (in author's collection through Staudinger and Bang-Haas).

From the other regional members of the *juncea* group, as *juncea* Meigen and *mystica* Alexander, the present fly differs especially in the hyaline wings, with distinct venational details, and minor differences in the structure of the male hypopygium.

TIPULA (LUNATIPULA) VALIDICORNIS Alexander.

Tipula (Lunatipula) validicornis ALEXANDER, Philip. Journ. Sci. 52 (1933) 322–324.

Described from eastern Siberia. Specimens from the Eastern Tombs, Hopei Province, northern China, altitude 4,875 feet, July 6, 1930 (male), July 5, 1930 (female) (*Ho*).

TIPULA HOI sp. nov. Plate 1, fig. 7.

General coloration of body polished ferruginous-yellow; præscutum with a very conspicuous black median stripe; legs yellow, long and slender; wings hyaline, the prearcular region, cells C and Sc, and the stigma conspicuously pale yellow; Rs much shorter than m-cu; ovipositor with cerci long and slender, straight.

Female.—Length, about 25 millimeters; wing, 20.

Frontal prolongation of head polished yellow; nasus distinct; palpi with basal two segments yellow, the terminal segments infuscated. Antennæ yellow, the outer flagellar segments a little more brownish yellow; scape elongate, slightly exceeding the first flagellar segment; flagellar segments with basal enlargements poorly to scarcely developed; longest verticils on outer face, each segment with additional elongate setæ at and near midlength of the segment on outer face; terminal segment long-oval, a little exceeding one-third the length of the penultimate. Head polished yellow.

Pronotum yellow. Mesonotal præscutum polished ferruginous-yellow, with a single, conspicuous, median, black stripe, narrowed behind and nearly attaining the suture; this stripe feebly divided on anterior half by a pale line; lateral stripes polished yellow, entirely concolorous with the interspaces but without short yellow setæ, as in the case of the latter; pseudosutural foveæ inevident; posterior sclerites of notum entirely polished ferruginous-yellow. Pleura polished ferruginous-yellow, entirely glabrous. Halteres yellow, the knobs weakly darkened. Legs long and slender, yellow, only the terminal two tarsal segments darkened; tibial spur formula 1–1–2. Wings (Plate 1, fig. 7) hyaline, the prearcular field, costal and subcostal cells, and the stigma conspicuously yellow, the two latter elements clearer but paler yellow; veins pale brown. Macrotrichia present on veins R_{2+3}, R_2, base of R_{1+2}, R_3, R_{4+5}, M_1, and M_2; lacking on Rs and remainder of medial field; squama naked. Venation: Sc_2 ending just beyond midlength of Rs, the latter short, subequal to R_{2+3} and much shorter than m-cu; R_{1+2} short, diverging strongly from R_3, its basal portion more thickened

and provided with trichia; petiole of cell M_1 only about one-third m; M_{3+4} subequal to basal section of M_3; m-cu at fork of M_{3+4}; cell M_4 wide at base; cell 2d A wide.

Abdomen polished ferruginous, without clearly defined darker marking. Ovipositor with cerci long and slender, straight, much exceeding the compressed hypovalvæ.

Habitat.—China (Hopei).

Holotype, female, Eastern Tombs, altitude about 4,875 feet, July 17, 1930 (*Ho*).

I take great pleasure in naming this fly in honor of Mr. Chi Ho, of the Fan Memorial Institute of Biology. *Tipula hoi* is a singularly beautiful species that bears a great resemblance to a large species of *Nephrotoma* but is unquestionably a species of *Tipula.* There is no described ally in eastern Asia, though somewhat similar forms occur in western North America. Without the male sex, I am unwilling to hazard an opinion as to the subgeneric position of the fly.

LIMONIINÆ

LIMONIINI

ORIMARGA (ORIMARGA) STREPTOCERCA sp. nov. Plate 1, fig. 8; Plate 2, fig. 29.

General coloration of thorax light gray; rostrum, palpi, and antennæ black; femora and tibiæ obscure yellow, the tips narrowly and conspicuously dark brown; wings pale yellow, the veins pale; R_{2+3} nearly as long as Rs; R_{1+2} and R_2 subequal; m-cu usually far basad, before level of origin of Rs; abdomen, including hypopygium, black; male hypopygium with the gonapophyses complex, the outer branch very strongly curved.

Male.—Length, about 6.5 millimeters; wing, 5.5.

Female.—Length, about 8 millimeters; wing, 7.

Rostrum and palpi black. Antennæ black throughout. Head light gray.

Mesonotum light gray, with three barely indicated præscutal stripes. Pleura almost uniformly light gray. Halteres pale throughout. Legs with the coxæ and trochanters whitish yellow; femora obscure yellow, the tips rather narrowly but conspicuously dark brown; tibiæ obscure yellow, the tips very narrowly dark brown; tarsi passing into dark brown. Wings (Plate 1, fig. 8) uniformly pale yellow, with pale veins. Costal fringe of moderate length; macrotrichia of veins beyond cord relatively numerous and well distributed, including a complete series of about 16 on vein R_3; about 25 on almost the entire length of the distal section of vein R_{4+5}; and about 15 on each

of veins M_{1+2} and M_3, restricted to the distal two-thirds of the veins. Venation: Sc_1 ending nearly opposite two-thirds the length of Rs, Sc_2 near its tip; R_2 and R_{1+2} subequal; R_{2+3} nearly as long as Rs; basal section of R_{4+5} strongly arcuated before midlength; M_{3+4} about two-thirds as long as M_4 alone; m-cu lying far basad before the level of origin of Rs; cell 2d A relatively long and wide.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 29) with the basistyle, *b*, unarmed, but with a heavy grouping of setæ on mesal face at base. Outer dististyle, *od*, slender, gently sinuous to the acute apex. Inner dististyle, *id*, subequal in length, with numerous setæ. Gonapophyses, *g*, complex, the outer branch very strongly curved, the distal free end a flattened blade with the tip acute.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, July 27, 1935 (*Franck*). Allotopotype, female.

By my key to the Chinese species of *Orimarga*[8] the present fly runs to *Orimarga* (*Orimarga*) *omeina* Alexander, which seems to be its nearest ally. The species is readily told by the pattern of the legs, the pale yellow wings with pale veins, and especially by the peculiar structure of the gonapophyses of the male hypopygium.

DICRANOPTYCHA CÆSIA PALLIDIBASIS Alexander.

Dicranoptycha cæsia pallidibasis ALEXANDER, Philip. Journ. Sci. **44** (1931) 353–354.

Described from the Japanese Alps, Shinano, Honshiu, Japan.

Two specimens, Eastern Tombs, Hopei, northern China, altitude 4,875 feet, July 6 to 10, 1930 (*Ho*).

PEDICIINI

DICRANOTA (RHAPHIDOLABIS) ANGULATA sp. nov. Plate 1, fig. 9.

Size large (wing, female, 7.5 millimeters); general coloration of thorax gray, the præscutum with three darker plumbeous-gray stripes, the posterior interspaces, scutellum, and cephalic portion of the mediotergite pale; halteres pale throughout; femora obscure yellow basally, the tips infuscated, broadly so on forelegs; wings yellowish subhyaline, the stigma merely indicated; veins pale yellowish brown; R_{2+3+4} present; Rs strongly arcuated to feebly angulated at near midlength.

Female.—Length, about 6 millimeters; wing, 7.5.

[8] Philip. Journ. Sci. **54** (1934) 327.

Rostrum and palpi brownish black. Antennæ with scape and pedicel black; flagellum broken. Head uniformly gray.

Pronotum and mesonotum gray, the præscutum with three darker plumbeous-gray stripes, the lateral pair narrow, the broad median vitta nearly reaching the suture; posterior interspaces passing into light brown; scutal lobes darkened; scutellum pale testaceous-brown, more yellowish behind; mediotergite with cephalic fourth yellowish, the remainder blackened, pruinose. Pleura chiefly light gray, the dorsal portion and the ventral sternopleurite darker brown. Halteres pale throughout. Legs with the coxæ and trochanters obscure yellow; femora obscure yellow basally, the tips infuscated, more extensively so on the forelegs where only about the proximal fourth is brightened; tibiæ pale brown, the tips narrowly darker; tarsi brownish black. Wings (Plate 1, fig. 9) yellowish subhyaline, the stigma merely indicated against the ground; veins pale yellowish brown. Venation: R_2 erect, subequal to or longer than R_{1+2}; R_{2+3+4} preserved, exceeding the basal section of R_5; Rs strongly arcuated to feebly angulated at near midlength.

Abdomen dark brown, sparsely pruinose. Ovipositor with the powerful upcurved cerci yellow.

Habitat.—Japan (Honshiu).

Holotype, female, Iwate-gun, Iwate-ken, altitude 3,000 feet, June 9, 1935 (*Yamamoto*).

The nearest described ally is *Dicranota* (*Rhaphidolabis*) *subconsors* Alexander, which differs most evidently in the smaller size, different thoracic coloration, and details of venation, especially of the radial field.

DICRANOTA (AMALOPINA) NEBULIPENNIS sp. nov. Plate 1, fig. 10; Plate 2, fig. 30.

General coloration pale yellowish white, including the palpi, antennæ, and legs; wings whitish hyaline, heavily variegated with brown and gray spots and clouds, including a major area occupying the outer radial field and large clouds at ends of veins Cu_1 and 2d A; abdomen pale yellow, the subterminal segments brown; male hypopygium with the interbasal structures flattened, their outer ends expanded and broadly obtuse.

Male.—Length, about 5.5 millimeters; wing, 6.5.

Rostrum, palpi, and antennæ entirely pale yellow, the latter relatively short. Head yellow.

Prothorax and mesothorax uniformly yellowish white. Halteres pale yellow throughout. Legs pale yellow, the outer tarsal segments dark brown. Wings (Plate 1, fig. 10) with the

ground color whitish hyaline, heavily spotted and marbled with pale brown and gray; cell C chiefly pale; crossveins and deflections with dark seams; a series of gray spots along vein Cu; outer radial and medial field chiefly covered by a large, irregular, darkened area extending across the outer radial field from R_{1+2} to the fork of M_{1+2}; large darkened clouds at ends of veins Cu_1 and 2d A; veins pale, darker in the clouded areas. Venation: A supernumerary crossvein in cell R_1; cell 1st M_2 closed; both sections of M_{3+4} subequal.

Abdomen pale yellow, the subterminal segments brown; hypopygium more yellowish brown. Male hypopygium (Plate 2, fig. 30) with the tip of basistyle, *b*, beset with abundant acute spines. Dististyle, *d*, simple, narrowed to outer end, which bears spinous setæ of various lengths. Interbase, *i*, a flattened rod, the distal portion broadly obtuse. Lateral tergal spine, *9t*, long and slender, the tip acute.

Habitat.—Japan (Honshiu).

Holotype, male, Iwate-gun, Iwate-ken, altitude 3,000 feet, May 17, 1935 (*Yamamoto*).

The heavily spotted wings suggest *Dicranota* (*Amalopina*) *siberica* Alexander, but in the present fly the pattern is unusually heavy, especially in the outer radial field.

HEXATOMINI

Genus ADELPHOMYIA Bergroth

Adelphomyia BERGROTH, Mittheil. Naturf. Ges. Bern für 1890 (1891) 134.

Oxydiscus DE MEIJERE, Tijd. voor Ent. 56 (1913) 350.

Subgenus PARADELPHOMYIA novum

Characters as in *Adelphomyia*, differing especially in the presence of a supernumerary crossvein in cell R_3 at near two-thirds the length (Plate 1, fig. 11).

Type of subgenus.—*Adelphomyia* (*Paradelphomyia*) *crossospila* sp. nov. (Eastern Palæarctic Region: Western China.)

The relationship of the present group to *Adelphomyia* is exactly comparable to that existing between *Dicranophragma* Osten Sacken and *Limnophila* Macquart.

ADELPHOMYIA (PARADELPHOMYIA) CROSSOSPILA sp. nov. Plate 1, fig. 11; Plate 2, fig. 31.

General coloration black, the sublateral portions of præscutum brighter; antennæ black, the basal flagellar segment pale; halteres and legs yellow; wings cream-colored, with a heavy brown

pattern, including a series of marginal spots; cell 1st M_2 elongate; anal veins strongly incurved to margin; male hypopygium with the outer dististyle terminating in three major spines; inner dististyle very broad, especially near base.

Male.—Length, about 3.5 millimeters; wing, 4.2.

Rostrum and palpi black. Antennæ black, 16-segmented; first flagellar segment whitish; flagellar segments elongate, the verticils exceeding the segments in length. Head brownish black.

Pronotum black. Mesonotal præscutum black, the region of the usual lateral stripes occupied by more brownish areas; posterior sclerites of mesonotum black. Pleura black. Halteres relatively elongate, whitish throughout. Legs with the fore and middle coxæ darkened; the posterior coxæ paler; trochanters obscure yellow; remainder of legs pale yellow, only the terminal tarsal segments darkened; tibial spurs present. Wings (Plate 1, fig. 11) cream-colored, the prearcular and costal regions clearer yellow; a conspicuous brown pattern, distributed as follows: Arculus; origin of Rs; stigma; tip of vein R_{1+2}; along cord and outer end of cell 1st M_2; supernumerary crossveins in cell R_3; a series of large areas at ends of all longitudinal veins, smallest on R_5, thence becoming progressively larger to the last anal vein; axillary margin infumed; veins pale, darkened in the infuscated areas. Coarse and sparse macrotrichia in cells R_2 to M_4, inclusive (indicated in figure by stippled dots). Venation: Sc_1 ending just before fork of Rs; R_2 a little shorter than R_{2+3}; a supernumerary crossvein in cell R_3; cell 1st M_2 very long, the second section of vein M_{1+2} exceeding any of the veins issuing from the cell; m about one-half the basal section of M_3; m-cu at near midlength of vein M_{3+4}; anal veins strongly curved into wing margin.

Abdomen, including hypopygium, black, the segments with long erect setæ. Male hypopygium (Plate 2, fig. 31) with the outer dististyle, *od,* armed at tip with three major spines, the two outermost curved. Inner dististyle, *id,* very broad, the surface set with numerous setæ and setulæ. Basistyle, *b,* obtuse at apex, not produced into a spinous apical point, as in certain other eastern Asiatic species of the genus, including *ariana* Alexander and *nipponensis* Alexander, but not *latissima* Alexander.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

This interesting *Adelphomyia* requires no comparison with any previously described member of the genus, since the subgeneric character of a supernumerary crossvein in cell R_3 of the wings is not possessed by any other species. The most generally similar form in the typical subgenus is *Adelphomyia* (*Adelphomyia*) *nebulosa* (de Meijere).

LIMNOPHILA (PHYLIDOREA) YAMAMOTOI sp. nov. Plate 1, fig. 12.

General coloration of entire body polished black; antennal flagellum and legs yellow; wings amber yellow, the basal and costal fields clearer yellow; outer veins brownish black, conspicuous; m-cu just before midlength of cell 1st M_2.

Female.—Length, about 10 millimeters; wing, 9.5.

Rostrum and palpi black. Antennæ with scape black; pedicel brownish yellow; flagellum pale yellow; flagellar segments elongate, with verticils that exceed the segments. Head black, sparsely pruinose, especially on anterior vertex.

Entire thorax polished black, only the membrane surrounding the wing root a little paler. Halteres pale yellow. Legs entirely pale yellow, excepting only the terminal three tarsal segments, which are darkened. Wings (Plate 1, fig. 12) chiefly clear amber yellow, the prearcular and costal regions a trifle clearer yellow; stigma not differentiated; veins in the prearcular and costal fields clearer yellow, the outer veins brownish black, conspicuous against the ground, these darkened elements including also veins M, Cu, 1st A, and 2d A. Venation: Sc_1 ending opposite the fork of Rs, Sc_2 longer, extending shortly beyond this fork; Rs relatively long, angulated at origin; veins R_{2+3} and R_5 approximated, cell R_3 widened beyond R_2; m-cu just before midlength of cell 1st M_2.

Abdomen entirely polished black, with long, erect, whitish setæ. Ovipositor with the genital shield and bases of cerci, as well as all of hypovalvæ, black, the tips of cerci paler.

Habitat.—Japan (Honshiu).

Holotype, female, Iwate-gun, Iwate-ken, altitude 3,000 feet, June 28, 1935 (*Yamamoto*).

This very distinct *Limnophila* is named in honor of the collector, Mr. Hiromu Yamamoto, to whom I am indebted for many Tipulidæ from northern Honshiu. The species is readily told from all other members of the subgenus by the uniformly polished black body, in conjunction with the entirely yellow legs and antennal flagellum.

LIMNOPHILA (IDIOPTERA) USSURIANA IWATENSIS subsp. nov.

Differs from the typical form (eastern Siberia) in various details.

Antennæ (female) black throughout; antennæ of male broken. Mesonotum uniformly black, sparsely pruinose, but without evident stripes. Pleura more conspicuously pruinose. Fore femora black, only the proximal fifth yellow; middle femora with about the basal third yellow; posterior femora with about the basal two-thirds yellow, gradually passing into black. Venation and wing pattern much as in the typical form. Abdomen black in both sexes, the hypopygium somewhat brightened. Male hypopygium with the terminal spine of the outer dististyle central in position and unusually small, the outer apical region of the style being expanded and glabrous. In typical *ussuriana* the spine is larger and arises from the outer apical portion of the style.

Habitat.—Japan (Honshiu).

Holotype, male, Iwate-gun, Iwate-ken, altitude 3,000 feet, June 21, 1935 (*Yamamoto*). Allotopotype, female, June 28, 1935.

It seems very probable to me that the present fly will deserve full specific rank when perfect specimens of the male become available. The subgenus *Idioptera* had not been recorded from the Japanese Empire.

ERIOPTERINI

CHIONEA GRACILISTYLA sp. nov. Plate 2, fig. 32.

Size small (length, male, 3.5 to 4.5 millimeters); legs moderately incrassated, the vestiture delicate; general coloration brown, the hypopygium and preceding segment blackened; antennæ 6-segmented, there being three flagellar segments beyond the fusion segment, the terminal segment small; male hypopygium with the outer lobe of dististyle preserved as a small bilobed blackened structure; inner lobe of dististyle slender, with a group of erect spines at and near apex, and with a conspicuous basal tubercle on mesal face; phallosome with both pairs of gonapophyses obtuse, not projecting caudad beyond level of ædeagus.

Male.—Length, about 3.5 to 4.5 millimeters.

General coloration (in alcohol) brown, the hypopygium and preceding segment brownish black to black; antennæ dark brown throughout. Legs yellowish brown.

Antennæ 6-segmented, there being three flagellar segments beyond the fusion; terminal segment a little less than one-half the penultimate. Legs, including the posterior pair, only moderately incrassated, more strongly so in the Amur paratypes; vestiture of legs consisting of long, erect, silken setæ. Male hypopygium (Plate 2, fig. 32) having the general structure of *C. nipponica,* there being a small, blackened, more or less bidentate, basal lobe or distinct style, *d,* at base of the long inner lobe, the latter relatively long and slender, with a triangular lobe or tooth on base of mesal face; distal end of style set with numerous microscopic spines. Phallosome, *p,* much as in *nipponica,* the gonapophyses incurved and not projecting caudad beyond the distal end of the ædeagus; lateral apophyses with delicate setulæ scattered over surface. In the Amur paratype, the lateral apophyses are broader and more truncated at their tips, the longer inner apophyses with the tips more slender and less expanded than in the Japanese type.

Habitat.—Japan; eastern Siberia.

Holotype, male on microscope slide, Chiosen, Honshiu, Japan (*Imanishi*) ; additional material from this same source in Kyoto Imperial University collection. Paratype, male, Tukuringa Mountains, Amur Province, eastern Siberia, November 1, 1915 (*Koshantschikov*), in the Russian Academy of Sciences.

The present fly is much smaller than *Chionea nipponica* Alexander, the only species hitherto described from eastern Asia, differing moreover in the marked reduction in the number of antennal segments, there being only six, instead of nine or ten. The nearest relative in the western Palæarctic fauna is *C. crassipes* Boheman, which has 7-segmented antennæ, dark, incrassated legs, and is of somewhat larger size. The antennæ of the holotype of the present insect are shriveled and possibly may not conform exactly to the description given above which is based primarily on the paratype. The western Nearctic *C. alexandriana* Garrett likewise has 6-segmented antennæ, but in all other regards is a very different fly.

GONOMYIA (LIPOPHLEPS) FUNESTA sp. nov. Plate 1, fig. 13.

Belongs to the *abbreviata* group; antennæ black throughout; pronotum and anterior lateral pretergites obscure yellow; mesonotum gray, the præscutum obscure yellowish gray; pleura almost uniformly reddish gray, the anepisternum and ventral sternopleurite a trifle darker; legs brownish black to black; wings with a strong brownish gray tinge, the prearcular field

yellow; cell 1st M_2 closed; abdominal tergites and sternites brownish black.

Female.—Length, about 4.8 millimeters; wing, 5.

Rostrum and palpi dark. Antennæ black throughout; segments passing through oval and long-oval to subcylindrical; longest verticils a trifle longer than the segments. Head dark-colored, the front and anterior vertex paler.

Pronotum and anterior lateral pretergites obscure yellow. Mesonotal præscutum and scutum dark brownish gray, the pseudosutural foveæ blackened; scutellum obscure yellowish gray; mediotergite gray. Pleura almost uniformly reddish gray, the anepisternum and ventral sternopleurite a trifle darker. Halteres obscure yellow, the knobs a little more obscure. Legs with the coxæ and trochanters obscure testaceous; remainder of legs brownish black or black. Wings (Plate 1, fig. 13) with a strong brownish gray tinge, the prearcular field and costal border more yellowish; stigmal region vaguely darkened, occupying most of cell R_1; veins brown, luteous at wing base. Venation: Sc short, with Sc_2 at tip of Sc_1; distance along vein R between Sc_2 and origin of Rs subequal to petiole of cell R_3; Rs short, arcuated to weakly angulated at origin; R_3 unusually erect, subequal to the distance on margin between veins R_{1+2} and R_3; cell 1st M_2 closed; m-cu shortly beyond fork of M.

Abdominal tergites and sternites brownish black, the genital segments only a little brightened; valves of ovipositor dark horn-colored.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

Allied to *Gonomyia* (*Lipophleps*) *gracilistylus* Alexander (Japan) and *G.* (*L.*) *prædita* Alexander (Formosa), differing chiefly in various colorational details, as the grayish mesonotum, darker thoracic pleura, uniformly darkened abdomen, and black legs. Unfortunately the male sex is still unknown.

GONOMYIA (GONOMYIA) JUSTIFICA sp. nov. Plate 1, fig. 14; Plate 2, fig. 33.

Belongs to the *subcinerea* group; antennæ black throughout; scutellum bright yellow; pleura yellow, variegated on anepisternum and ventral sternopleurite by reddish brown; legs black; wings with a strong brown tinge, the prearcular and costal portions a little more yellowish; vein R_{2+3+4} strongly arched; male hypopygium with both the inner dististyle and the ædeagus bearing a single, blackened, spinous point.

Male.—Length, about 3.5 millimeters; wing, 4.2.

Rostrum obscure yellow; palpi black. Antennæ black throughout; flagellar segments long-oval to elongate; longest verticils exceeding the segments. Head gray.

Pronotum and anterior lateral pretergites light sulphur yellow. Mesonotal præscutum dark brownish gray, the humeral region obscure yellow; scutal lobes similarly dark brownish gray, the median area broadly obscure yellow; scutellum bright yellow; mediotergite brownish gray, the cephalic lateral angle more yellowish. Pleura yellow, variegated by reddish brown on the anepisternum and ventral sternopleurite; dorsopleural region yellow. Halteres yellow, the knobs weakly darkened. Legs with the coxæ reddish brown; trochanters obscure yellow; remainder of legs black. Wings (Plate 1, fig. 14) with a strong brown tinge, the prearcular and costal portions a little more yellowish; stigma vaguely darkened; veins brown, more luteous in the yellow areas. Venation: Sc_1 ending shortly beyond origin of Rs, the distance slightly variable, in the type being immediately opposite this origin; R_{2+3+4} strongly arched; m-cu slightly variable in position, from close to, to about one-third its own length beyond, the fork of M.

Abdominal tergites brown, the sternites yellow; hypopygium yellow. Male hypopygium (Plate 2, fig. 33) with the basistyle, *b*, produced apically into a short lobe. Outer dististyle, *od*, a long pale cylindrical lobe, provided with scattered setæ, including a group of longer ones at apex. Inner dististyle, *id*, triangular in outline, terminating in a single, powerful, horn-like spine. Phallosome, *p*, with a single blackened spine, arising near base.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*). Paratopotype, male.

The nearest regional ally of the present fly is *Gonomyia* (*Gonomyia*) *omeiensis* Alexander, which differs especially in the details of wing venation and structure of the male hypopygium, notably of both dististyles.

ERIOPTERA (ERIOPTERA) HOLOXANTHA sp. nov. Plate 1, fig. 15; Plate 3, fig. 34.

Size large (wing, male, over 6 millimeters); general coloration yellow, including the antennæ, halteres, and legs; wings strongly suffused with yellow, the veins darker yellow; male hypopygium with the outer dististyle short-stemmed, the outer half expanded into a triangular head, its distal margin thickened and more or less bifid on outer cephalic angle; inner dististyle

long and slender, gently curved, narrowed to the acute decurved apex, on outer face at near three-fourths the length with a low blackened tooth.

Male.—Length, about 5.5 to 6 millimeters; wing, 6.5 to 6.8. Rostrum yellow; palpi pale brown. Antennæ pale yellow, the outer segments a trifle darker; flagellar segments oval, the outer ones more attenuated. Head uniformly light yellow.

Pronotum yellow. Anterior lateral pretergites pale sulphur yellow. Mesonotal præscutum yellow, with three more reddish brown stripes that are but little conspicuous against the ground; humeral region brighter yellow; posterior sclerites of mesonotum yellow. Pleura pale yellow. Halteres pale yellow throughout. Legs yellow, only the outer tarsal segments a trifle darkened. Wings (Plate 1, fig. 15) with a strong, uniform yellow suffusion, the veins deeper yellow; outer costal fringe a little darkened. Venation: Vein 2d A rather strongly sinuous on distal third.

Abdomen, including hypopygium, yellow, the gonapophyses and distal end of outer dististyle blackened. Male hypopygium (Plate 3, fig. 34) with the outer dististyle, *od,* short-stemmed, the outer half expanded into a triangular head, its distal margin thickened and more or less bifid on outer cephalic angle, the surface unroughened. Inner dististyle, *id,* long and slender, gently curved, narrowed to the acute decurved apex; on outer face at near three-fourths the length with a low, obtuse, blackened tooth. Gonapophyses, *g,* appearing as slender, straight rods, the margins smooth, the distal half of each intensely blackened.

Habitat.—Japan (Honshiu).

Holotype, male, Iwate-gun, Iwate-ken, altitude, 3,000 feet, July, 7, 1935 (*Yamamoto*). Paratopotypes, 7 males.

In its general appearance the present fly is most similar to such species as *Erioptera* (*Erioptera*) *flavescens* (Linnæus), *E.* (*E.*) *flavohumeralis* Alexander, and *E.* (*E.*) *xanthoptera* Alexander, differing from all in the larger size, the yellow body coloration, and especially the hypopygial structure.

ERIOPTERA (EMPEDA) NIGROSTYLATA sp. nov. Plate 1, fig. 16; Plate 3, fig. 35.

General coloration gray; halteres light yellow throughout; legs dark brown, the femora with abundant appressed flattened scales, in addition to the usual setæ; wings grayish subhyaline, the prearcular and costal regions slightly more yellow; Sc_1 ending about opposite midlength of Rs; veins R_3 and R_4 both relatively long and lying generally parallel to one another; male hypopygium with the outer dististyle entirely blackened, bifid, with both arms glabrous.

Male.—Length, 3.5 to 4 millimeters; wing, 3.5 to 4.

Female.—Length, about 4 millimeters; wing, 4.

Rostrum, palpi, and antennæ black. Head light gray.

Anterior lateral pretergites light yellow. Mesonotal præscutum gray laterally, more brownish gray medially; posterior sclerites of mesonotum light gray. Pleura gray. Halteres clear light yellow throughout. Legs with the coxæ and trochanters yellow; remainder of legs dark brown; femora with appressed flattened scales interspersed with the setæ. Wings (Plate 1, fig. 16) grayish subhyaline, the prearcular and costal region slightly more yellow; veins brown, more luteous in the yellow regions. Venation: Sc relatively long, Sc_1 ending near midlength of Rs; veins R_3 and R_4 both relatively long and lying generally parallel to one another; m-cu at fork of M.

Abdomen dark brown, the hypopygium yellow. Male hypopygium (Plate 3, fig. 35) with the outer dististyle entirely blackened, both arms smooth, the outer slender and more or less parallel-sided; inner arm much expanded at distal end. Inner dististyle, *id,* appearing as a pale compressed blade.

Habitat.—China (Szechwan).

Holotype male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*). Allotopotype, female. Paratopotypes, males and females.

The present fly is quite distinct from the other species of *Empeda* so far described from Palæarctic Eastern Asia in the long Sc, appressed scales on femora, and structure of the outer dististyle of the male hypopygium. It is apparently most nearly related to *Erioptera* (*Empeda*) *sulfureoclavata* Alexander, which has the styli of the male hypopygium entirely pale.

ORMOSIA NIGRIPENNIS sp. nov. Plate 1, fig. 17; Plate 3, fig. 36.

Belongs to the *nigripila* group; general coloration black, the præscutum and scutum rich reddish brown; antennal flagellum obscure yellow; legs (male) with femora black, tibiæ abruptly yellow; legs (female) black, the extreme bases of tibiæ yellow; wings with a strong blackish tinge, the stigmal area a trifle darker; cell 1st M_2 closed, small; anal veins divergent; male hypopygium with the gonapophyses appearing as flattened blades, the tips simple, acute.

Male.—Length, about 4.2 to 4.4 millimeters; wing, 5.

Female.—Length, about 5 to 5.5 millimeters; wing, 5.2 to 5.8.

Rostrum and palpi black. Antennæ with scape and pedicel dark, flagellum obscure yellow; flagellar segments short-cylin-

drical, with verticils that exceed the segments in length. Head dark.

Pronotum black. Anterior lateral pretergites restrictedly obscure yellow. Mesonotal præscutum and scutum rich reddish brown, the anterior portion of the former a little darkened; scutellum brown; mediotergite black. Pleura black. Halteres yellow, with light yellow setæ. Legs with the coxæ black; trochanters brighter; in male with femora black, the tibiæ abruptly yellow, the tarsi passing into brown; in female, legs entirely black, excepting the yellow extreme bases of tibiæ. Wings (Plate 1, fig. 17) with a strong blackish tinge throughout, the stigmal field only a trifle darker; veins a little darker than the ground. Macrotrichia dark, well distributed over the wing surface, lacking in the bases of the cells on both sides of arculus (shown by stippled dots in figure). Venation: Sc_1 ending opposite R_2, Sc_2 about opposite one-third the length of Rs; R_2 subequal to R_{2+3}, oblique; cell 1st M_2 closed, small, as in the group; m-cu sinuous, at fork of M; anal veins divergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 36) as in the group. Ninth tergite deeply concave caudally. Inner dististyle, *id*, with five powerful subequal setæ. Gonapophyses, *g*, appearing as strong flattened blades, the long-extended tips acute, simple. Ovipositor with cerci horn yellow, hypovalvæ black.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female, summit, altitude 11,000 feet, July 30, 1935. Paratopotypes, 3 males; paratypes, 1 female, with allotype.

The nearest described ally is *Ormosia diversipes* Alexander (Japan), which differs especially in the larger size, darkened mesonotum, paler, more grayish brown wings, with slightly different venational details, and the male hypopygium, especially the deeply bifid gonapophyses. The striking difference in the coloration of the legs of the two sexes of the present fly is exactly paralleled in *O. diversipes*, and the name *O. atripes* Alexander, based on the female sex of this species, must be placed in the synonymy. It is strange that none of the numerous Nearctic species of the *nigripila* group shows this sexual dimorphism.

ORMOSIA TENUISPINOSA sp. nov. Plate 1, fig. 18; Plate 3, fig. 37.

Belongs to the *similis* group; general coloration dark gray; antennæ (male) elongate, exceeding one-half the length of body;

halteres yellow; legs black; wings obscure yellow, patterned with darker, including cell C, stigmal area, seams along cord and outer fork of M, and a narrow apical darkening; anal veins convergent; abdomen, including hypopygium, black; male hypopygium with the ninth tergite broad, its caudal margin gently concave; outer gonapophyses of unusual length and slenderness, trispinous.

Male.—Length, about 5 millimeters; wing, 5.5; antenna, about 2.8.

Rostrum gray; palpi black. Antennæ black throughout, of unusual length when compared with other regional species, if bent backward extending to shortly beyond the base of abdomen; basal flagellar segment unusually long and apparently formed by the fusion of two normal segments; succeeding segments elongate, the outer ones becoming more nearly cylindrical; segments with individual elongate secund verticils and a shorter dense erect pale pubescence. Head dark gray.

Pronotum dark gray. Anterior lateral pretergites obscure. Mesonotum and pleura almost uniformly dark gray, the præscutum a trifle more brownish gray, not at all brightened; pseudosutural foveæ and tuberculate pits black. Halteres golden yellow. Legs with the coxæ gray; trochanters brownish yellow; remainder of legs black. Wings (Plate 1, fig. 18) with the ground color obscure yellowish brown, rather conspicuously patterned with darker; cell C chiefly infuscated; stigmal area and seams along cord, together with outer fork of M darkened; apical border of wing narrowly and inconspicuously darkened, not appearing as dark spots at ends of veins; prearcular field restrictedly yellow; veins pale in the ground areas, darker in the infuscated portions. Macrotrichia of cells abundant (indicated in figure by stippled dots). Venation: R_2 more than twice R_{2+4}; m-cu at fork of M; anal veins sinuous, convergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 37) with the tergite, *9t,* broad, duplicated beneath, the outer margin gently concave; isolated patches of setæ in pale membrane before outer end of tergite. Inner dististyle, *id,* narrow, more or less triangular in outline. Gonapophyses entirely blackened, the outer pair, *og,* very conspicuous, slender, the longer axial spine strongly decurved; inner apophysis, *ig,* bidentate at apex.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*).

The combination of elongate antennæ and structure of the male hypopygium readily separates the present fly from any of the other regional species. I am using the term *similis* group for numerous species in the Holarctic Region that have the outer dististyle of the hypopygium more or less flattened-clavate, the outer surface clothed with parallel rows of closely appressed spines or spinous setæ.

ORMOSIA FIXA sp. nov. Plate 1, fig. 19; Plate 3, fig. 38.

Belongs to the *similis* group; general coloration, including præscutum, dark gray; antennæ short, black throughout; halteres light yellow; legs black; wings weakly suffused with brownish, cell C and the stigma darker; anal veins convergent; abdomen, including hypopygium, black; male hypopygium with the outer gonapophyses profoundly divided, the outer arm stouter, bearing a small lateral spine before apex; inner dististyle a horn-colored flattened blade, the apex acute, the outer margin with conspicuous setæ.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ black throughout, short, if bent backward extending about halfway to the wing root; flagellar segments oval, the longest verticils unilaterally distributed and approximately two or more times as long as the segment; flagellar segments gradually decreasing in length outwardly. Head dark gray.

Mesothorax almost uniformly dark gray, the præscutum with the pseudosutural foveæ and tuberculate pits black. Halteres with base of stem dusky, the remainder light yellow. Legs with the coxæ dark gray; trochanters brownish black; remainder of legs black. Wings (Plate 1, fig. 19) weakly suffused with brownish, cell C darker; stigmal region infumed; a scarcely indicated brown tinge along cord; veins dark brown. Macrotrichia numerous (indicated in figure by stippled dots). Venation: Sc_2 about opposite midlength of Rs; R_2 close to fork of R_{2+3+4}, R_{2+3} being thus obliterated or virtually so; union of distal section of vein M_3 and m angulated; m-cu close to fork of M; anal veins convergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 38) with the ninth tergite, *9t,* having the apex entire, gently convex. Inner dististyle moderately broad, the apex bearing the usual fasciculate bristle hyaline. Outer gonapophyses, *og,* black, profoundly divided, the inner arm a long slender rod, the apex obtuse; outer arm much stouter, from an

expanded base, before apex bearing a small lateral spine. Inner gonapophyses, *ig,* appearing as curved flattened blades, horn-colored, the apex of each acute; outer margin with conspicuous setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*).

The present species is quite distinct from other black-legged regional species in the group in the short black antennæ and the somewhat peculiar structure of the male hypopygium, notably of the gonapophyses.

ORMOSIA PROFESTA sp. nov. Plate 1, fig. 20; Plate 3, fig. 39.

Belongs to the *similis* group; antennæ and legs black; mesothorax dark gray; legs black; wings rich buff-yellow, conspicuously variegated by dark spots and seams, including a marginal series on all longitudinal veins; abdomen black; male hypopygium with the outer gonapophyses appearing as flattened plates, the outer angle produced into a strong spine, the remainder of the apophysis terminating in from six to ten smaller teeth.

Male.—Length, about 5 millimeters; wing, 6.

Rostrum and palpi black. Antennæ black throughout, of moderate length. Head dark gray.

Pronotal scutellum obscure yellow. Mesonotum dark gray, without distinct markings, the humeral areas of the præscutum a trifle brighter; pseudosutural foveæ and tuberculate pits black. Pleura gray. Halteres light yellow throughout. Legs with the coxæ brownish gray; trochanters obscure yellow; remainder of legs black. Wings (Plate 1, fig. 20) rich buff-yellow, with a conspicuous brown pattern, including areas at origin of Rs; Sc_2; tip of Sc_1, the latter confluent with a band across cord; a cloud at outer fork of M; marginal spots at ends of all longitudinal veins, somewhat larger and more conspicuous in the radial field; cell C slightly more infumed than cell Sc; stigmal area, between the dark spots at tips of veins Sc_1 and R_{1+2}, more saturated yellow; veins and macrotrichia yellow, darker in the infuscated areas. Macrotrichia unusually abundant, including cell Cu, lacking only in the basal portions of cell Sc (shown in figure by stippled dots). Venation: Sc_1 ending opposite R_2; veins R_3 and R_4 slightly upcurved at tips; cell 1st M_2 open; union of m and distal section of vein M_3 a gentle curve; vein 2d A sinuous.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 39) with the tergite, 9*t*, relatively narrow, the apex

slightly narrower than base, transverse, set with abundant delicate setulæ. Outer dististyle, *od,* a flattened scooplike structure, set with numerous transverse to oblique rows of spinous setæ, as in group. Inner dististyle, *id,* produced outwardly into a narrow point that bears a single strong fasciculate seta. Gonapophyses of powerful structure; outer pair, *og,* darkened, expanded distally, the apex with numerous spinous points, including a strong outer spine; the number of lesser apical points ranges from six to ten on the two sides of the type, so is evidently a highly variable character; at base of apophysis a slender smooth rod. Inner gonapophysis, *ig,* a little shorter than the outer, darkened, at apex produced into two flattened flaplike lobes, their tips acute.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

The only other species from this general region having somewhat similarly patterned wings is *Ormosia auricosta* Alexander, which differs in the yellow legs, with narrow subterminal darkened ring on femora, and in the strongly suffused wings with much brighter costal border.

ORMOSIA OFFICIOSA sp. nov. Plate 1, fig. 21; Plate 3, fig. 40.

Belongs to the *nimbipennis* group; general coloration of thorax black, the præscutum and scutum reddish brown; antennæ (male) of moderate length, dark throughout; male hypopygium with a single well-developed dististyle, appearing as a curved hook, the apical fifth blackened; gonapophyses appearing as blackened toothlike structures, without evident lateral denticles.

Male.—Length, about 4 millimeters; wing, 4.5; antenna, about 1.6.

Female.—Length, about 4.5 millimeters; wing, 4.8 to 5.

Rostrum and palpi black. Antennæ of moderate length, dark throughout; flagellar segments subcylindrical to long-oval. Head dark.

Mesonotal præscutum and scutum reddish brown, the scutellum, postnotum, and pleura conspicuously blackened. Halteres clear pale yellow, the stem a trifle darker. Legs with the coxæ dark; trochanters obscure yellow; femora dark brown, with dark setæ; tibiæ and tarsi a trifle brighter in color. Wings (Plate 1, fig. 21) with a very pale brown tinge, cells C and Sc a trifle darker; stigmal region infuscated; veins pale, those along the cord a little darker. Macrotrichia of cells relatively numerous

though lacking in bases of cells M to 2d A (indicated in figure by stippled dots). Venation: Sc_2 shortly before midlength of Rs; R_2 oblique, subequal to R_{2+3}; outer fork of M gently curved to subangular; m-cu close to fork of M; anal veins convergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 40) with the tergal plate, *9t*, gently expanded outwardly, the caudal end feebly emarginate. A single well-developed dististyle, *d*, as in the group, appearing as a curved hook, the apical fifth blackened; on the concave side before tip with several setæ; other scattered setæ nearer base of style; a small obtuse structure at base of style presumably represents the usual second dististyle. Gonapophyses, *g*, reduced to blackened, conical, toothlike structures. Ædeagus expanded on basal two-thirds, the apical portion slender, the tip decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female, pinned with type. Paratopotypes, males and females.

The nearest ally is the species herewith described as *Ormosia affixa* sp. nov., which differs most evidently in the longer antennæ of the male and in details of structure of the hypopygium.

ORMOSIA AFFIXA sp. nov. Plate 1, fig. 22; Plate 3, fig. 41.

Belongs to the *nimbipennis* group; general coloration of thorax dark gray, the præscutum and scutum reddish brown; antennæ (male) relatively elongate, if bent backward extending nearly to root of halteres; male hypopygium with the outer dististyle blackened, the surface with numerous setigerous punctures and tubercles; gonapophyses blackened, acute at tip, each with a sharp lateral spine on outer margin at near midlength.

Male.—Length, about 5 millimeters; wing, 5.5 to 5.8; antenna, about 2.

Rostrum and palpi black. Antennæ black, relatively elongate, as shown by the measurements; if bent backward extending nearly to root of halteres; flagellar segments long-cylindrical, with a dense, erect, white pubescence and scattered verticils. Head dark gray.

Pronotum dark brownish gray. Mesonotal præscutum and scutum reddish brown, contrasting with the dark gray scutellum, postnotum, and pleura. Halteres light yellow. Legs with the coxæ dark gray; trochanters brownish yellow; remainder of legs chiefly dark brown, the tarsi passing into black. Wings (Plate 1, fig. 22) with a faint brown tinge, the costal cell and stigma

darker; veins brown. Venation: R_2 at or close to fork of R_{3+4}, in cases beyond this fork to a distance subequal to its length; outer fork of M not or scarcely angulate; m-cu at fork of M; anal veins convergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 41) very similar in structure to *O. officiosa* sp. nov., but differing in several details. Dististyle, *d*, chiefly blackened, with numerous setigerous punctures and small tubercles. Gonapophyses, *g*, blackened, acute at tip, with a sharp lateral spine on outer margin at near midlength; a smaller, curved, fingerlike lobule at base, presumably representing the rudimentary outer apophyses. Ædeagus less dilated on basal portion.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Paratopotypes, 2 males.

The nearest ally is *Ormosia officiosa* sp. nov., which differs especially in the smaller size, shorter antennæ of the male, and slight but constant differences in the male hypopygium. The remaining members of the *nimbipennis* group are restricted to the eastern Nearctic Region.

DASYMOLOPHILUS JUBATUS sp. nov. Plate 1, fig. 23; Plate 3, fig. 42.

Wings broad, without macrotrichia in centers of cells; male hypopygium with the ædeagus bent at a right angle; phallosomic structure a slender pale rod, without spinous armature.

Male.—Length, about 1.8 to 2 millimeters; wing, 2.5 to 2.6.

Female.—Length, about 2.5 millimeters; wing, about 2.8.

Rostrum and palpi black. Antennæ brownish black, relatively short, if bent backward ending some distance before wing root. Head dark brown.

Thorax brownish black to dark brown, both the pronotum and mesonotum with very long erect black setæ. Halteres with base of stem pale, the remainder brownish black. Legs black throughout. Wings (Plate 1, fig. 23) grayish, with darker brownish gray veins; macrotrichia and setal fringes dark brown. Wings slightly wider than in *nokoensis;* no macrotrichia in cells, the only ones present being close to outer margin of wing. Venation: R_2 and R_{2+3} in transverse alignment and lying just basad of the basal section of R_5 and r-m.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 42) with the dististyle, *d*, unusually long and slender, the apical point a long blackened spine; subapical spine elongate, preceded by a series of four or five smaller, more dorsal

denticles. Ædeagus *a*, bent at a right angle just beyond mid-length. Phallosomic structure, *p*, a slender, pale rod that does not attain the point of angulation of the ædeagus, without spinous armature.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 6,500 feet, July 31, 1935 (*Franck*). Allotopotype, female. Paratopotypes, males.

The nearest relative is *Dasymolophilus nokoensis* Alexander, of Formosa. The various regional species may be separated by the following key:

Key to the Palæarctic species of Dasymolophilus.

MALES

1. Outer cells of wing with series of macrotrichia appearing in linear rows along the centers of certain cells, especially M_4 .... 2.
   Cells of wing without macrotrichia, except for scattered marginal ones at extreme outer ends of cells .... 3.
2. Phallosomic structure appearing as a slender strobiloid rod, with scattered spinose points. (Japan, Formosa.) .... *kibunensis* sp. nov.
   Phallosomic structure large, heavily blackened, with obtuse denticles on outer face. (Europe.) .... *murinus* (Meigen).
3. General coloration of mesonotum and pleura light brown; wings relatively narrow. (Formosa.) .... *nokoensis* Alexander.
   General coloration of mesonotum and pleura brownish black; wings broader. (Western China.) .... *jubatus* sp. nov.

DASYMOLOPHILUS KIBUNENSIS sp. nov. Plate 3, fig. 43.

Male.—Length, about 1.6 to 1.7 millimeters; wing, 2.4 to 2.5.

Characters as in *D. murinus* (Meigen), differing especially in the structure of the male hypopygium.

A restricted series of macrotrichia in cells of wings, most persistent as a linear row up the center of cell M_4 between m-cu and fork of M_{3+4}; in the type specimen, with such trichia in outer ends of cells R_2, R_3, R_4, R_5, M_2, and M_3. Venation: m-cu slightly variable in position, in the holotype located less than its own length before the fork of M, in other cases a little more than this length.

Male hypopygium (Plate 3, fig. 43) with the dististyle, *d*, slender, the apical point relatively short, preceded by four or five acute spines, with a partial second row of smaller spinulæ. Ædeagus, *a*, nearly straight, the distal third angularly bent. Phallosomic structure, *p*, small, subcylindrical to nearly terete, covered with microscopic spinulose points to appear somewhat strobiloid.

Habitat.—Japan, Formosa.

Holotype, male, Kibune, Kyoto, Honshiu, Japan, altitude 750 feet, at light, June 1, 1930 (*Tokunaga*); on slide. Paratopotypes, 2 males, on slide. Paratype, male, Arisan, Formosa, altitude 6,500 to 8,000 feet, July 7, 1929 (*Issiki*).

The Formosan paratype certainly appears to be conspecific with the Japanese types. The species is most nearly allied to the European *Dasymolophilus murinus* (Meigen), the interrelationships being shown in the key provided under the account of the preceding species. *Dasymolophilus murinus* has the phallosomic structure (Plate 3, fig. 44, *p*) of the male hypopygium considerably larger, more sclerotized and blackened, and of distinct construction.

MOLOPHILUS OKADAI sp. nov. Plate 1, fig. 24; Plate 3, fig. 45.

Belongs to the *gracilis* group and subgroup; general coloration of entire body intense black; antennæ short, flagellum pale brown; halteres yellow; legs yellow, the femoral tips broadly and conspicuously blackened; tibial bases narrowly, the tips more broadly, blackened; outer four tarsal segments black; wings uniformly suffused with grayish yellow, the prearcular and costal regions clearer yellow; veins yellowish brown; male hypopygium with the dorsal lobe of basistyle bifid; both dististyles simple, with microscopic spinulæ on distal portions.

Male.—Length, about 3.2 to 3.4 millimeters; wing, 4.2 to 4.5.

Female.—Length, about 4 millimeters; wing about 5.

Head and palpi black. Antennæ short in both sexes; scape and pedicel black; flagellum pale brown; flagellar segments oval, the verticils much exceeding the segments.

Thorax entirely intense black. Halteres yellow. Legs of male with the coxæ brownish black; trochanters yellow; femora light yellow, the tips broadly and conspicuously blackened, including about the distal third on fore and middle legs and about the distal fourth on the posterior legs; tibiæ yellow, the bases very narrowly, the tips somewhat more extensively blackened, the latter about equal to from one-third to one-half the femoral darkening; basitarsi yellow, the tips and remainder of tarsi brownish black. Wings (Plate 1, fig. 24) uniformly suffused with grayish yellow, the prearcular and costal portions clearer light yellow; veins yellowish brown, clearer yellow in the more luteous portions. Venation: R_2 opposite or slightly before r-m; m-cu about one-third to one-half the petiole of cell M_3; vein 2d A relatively long, extending beyond the cephalic end of m-cu.

Abdomen, including hypopygium and all appendages, intense black. Male hypopygium (Plate 3, fig. 45) with the dorsal lobe of basistyle, *db*, appearing as a double structure, the outer spine straight, narrowed to an acute point, the surface of outer half with microscopic appressed spinulæ; inner arm a glabrous curved spine; ventral lobe of basistyle, *vb*, a long clavate structure, provided with abundant, very long, recurved setæ. Outer dististyle, *od*, longer than the other appendages of the hypopygium, the basal half a trifle expanded, the outer portion gently curved and densely set with microscopic appressed spinulæ. Inner dististyle, *id*, smaller, the base expanded, the long apical spine with several small erect conical spines.

Habitat.—Japan (Hokkaido).

Holotype, male, Sapporo, Ishikari, July 2, 1935 (*Okada*). Allotopotype, female. Paratopotypes, 4 males and females.

Holotype and allotype returned to Professor Okada for inclusion in the Entomological Museum, Hokkaido Imperial University; paratypes in author's collection.

I take unusual pleasure in naming the species in honor of the collector, Prof. I. Okada. The fly is the most distinctively colored species so far discovered in eastern Asia. The coloration of the legs is very striking, somewhat similar to the condition found in the otherwise very different *Molophilus nakamurai* Alexander (Japan). In the present species the uniformly black body, in conjunction with the pale wings, is very conspicuous.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b*, basistyle; *d*, dististyle; *db*, dorsal lobe of basistyle; *g*, gonapophysis; *id*, inner dististyle; *ig*, inner gonapophysis; *od*, outer dististyle; *og*, outer gonapophysis; *p*, phallosome; *s*, sternite; *t*, tergite; *vb*, ventral lobe of basistyle.]

PLATE 1

FIG. 1. *Ptychoptera sumatrensis* sp. nov.; venation.
2. *Ctenophora yezoana nigrobasalis* subsp. nov.; venation.
3. *Ctenophora femur-rubra* sp. nov.; venation.
4. *Tipula (Tipulodina) hopeiensis* sp. nov.; venation.
5. *Tipula (Oreomyza) pingi* sp. nov.; venation.
6. *Tipula (Oreomyza) platyglossa* sp. nov.; venation.
7. *Tipula hoi* sp. nov.; venation.
8. *Orimarga (Orimarga) streptocerca* sp. nov.; venation.
9. *Dicranota (Rhaphidolabis) angulata* sp. nov.; venation.
10. *Dicranota (Amalopina) nebulipennis* sp. nov.; venation.
11. *Adelphomyia (Paradelphomyia) crossospila* sp. nov.; venation.
12. *Limnophila (Phylidorea) yamamotoi* sp. nov.; venation.
13. *Gonomyia (Lipophleps) funesta* sp. nov.; venation.
14. *Gonomyia (Gonomyia) justifica* sp. nov.; venation.
15. *Erioptera (Erioptera) holoxantha* sp. nov.; venation.
16. *Erioptera (Empeda) nigrostylata* sp. nov.; venation.
17. *Ormosia nigripennis* sp. nov.; venation.
18. *Ormosia tenuispinosa* sp. nov.; venation.
19. *Ormosia fixa* sp. nov.; venation.
20. *Ormosia profesta* sp. nov.; venation.
21. *Ormosia officiosa* sp. nov.; venation.
22. *Ormosia affixa* sp. nov.; venation.
23. *Dasymolophilus jubatus* sp. nov.; venation.
24. *Molophilus okadai* sp. nov.; venation.

PLATE 2

FIG. 25. *Tipula (Tipulodina) hopeiensis* sp. nov.; male hypopygium, details.
26. *Tipula (Tipulodina) hopeiensis* sp. nov.; male hypopygium, details.
27. *Tipula (Oreomyza) pingi* sp. nov.; male hypopygium, details.
28. *Tipula (Oreomyza) platyglossa* sp. nov.; male hypopygium, details.
29. *Orimarga (Orimarga) streptocerca* sp. nov.; male hypopygium.
30. *Dicranota (Amalopina) nebulipennis* sp. nov.; male hypopygium.
31. *Adelphomyia (Paradelphomyia) crossospila* sp. nov.; male hypopygium.
32. *Chionea gracilistyla* sp. nov.; male hypopygium.
33. *Gonomyia (Gonomyia) justifica* sp. nov.; male hypopygium.

PLATE 3

FIG. 34. *Erioptera* (*Erioptera*) *holoxantha* sp. nov.; male hypopygium.
35. *Erioptera* (*Empeda*) *nigrostylata* sp. nov.; male hypopygium.
36. *Ormosia nigripennis* sp. nov.; male hypopygium.
37. *Ormosia tenuispinosa* sp. nov.; male hypopygium.
38. *Ormosia fixa* sp. nov.; male hypopygium.
39. *Ormosia profesta* sp. nov.; male hypopygium.
40. *Ormosia officiosa* sp. nov.; male hypopygium.
41. *Ormosia affixa* sp. nov.; male hypopygium.
42. *Dasymolophilus jubatus* sp. nov.; male hypopygium.
43. *Dasymolophilus kibunensis* sp. nov.; male hypopygium.
44. *Dasymolophilus murinus* (Meigen); male hypopygium.
45. *Molophilus okadai* sp. nov.; male hypopygium.

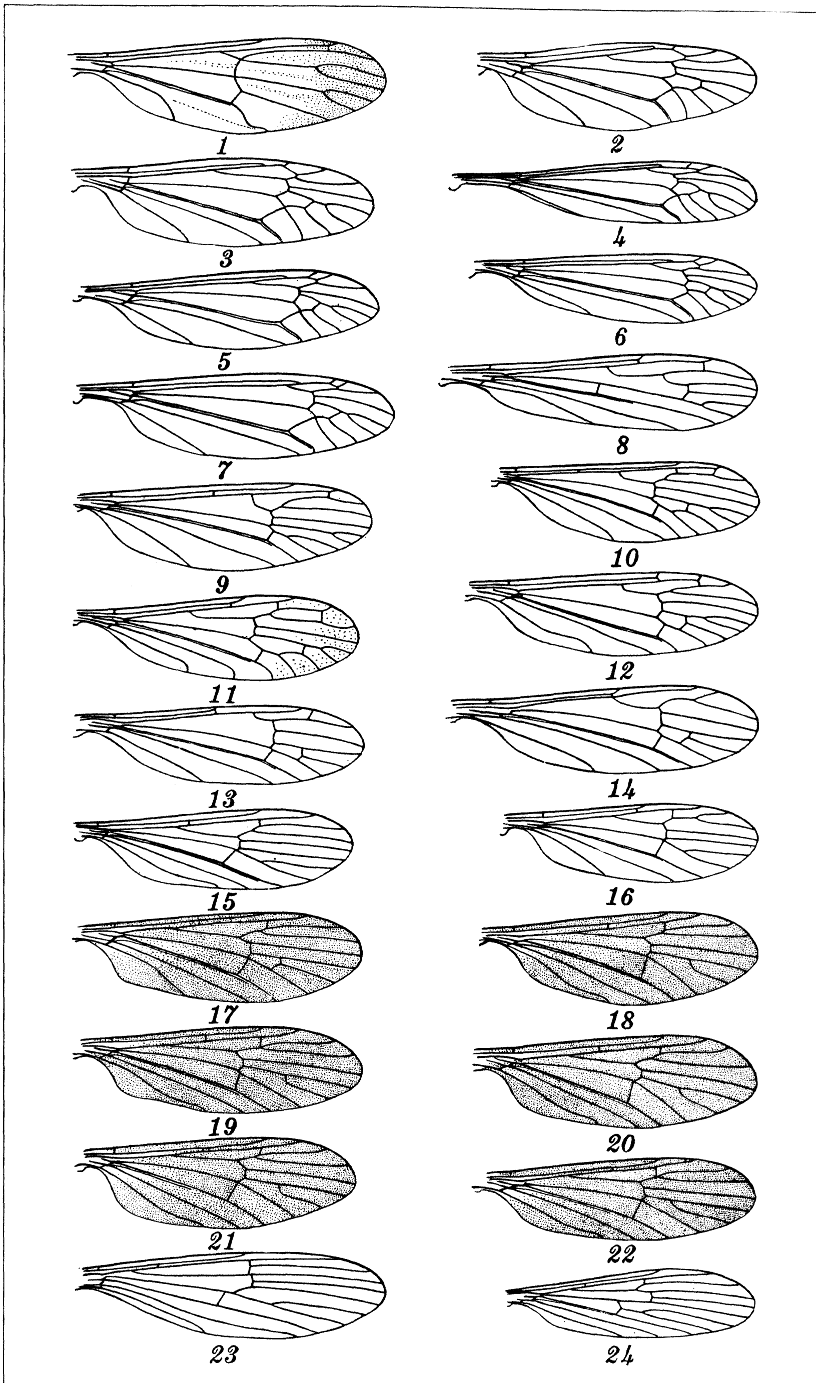

PLATE 1.

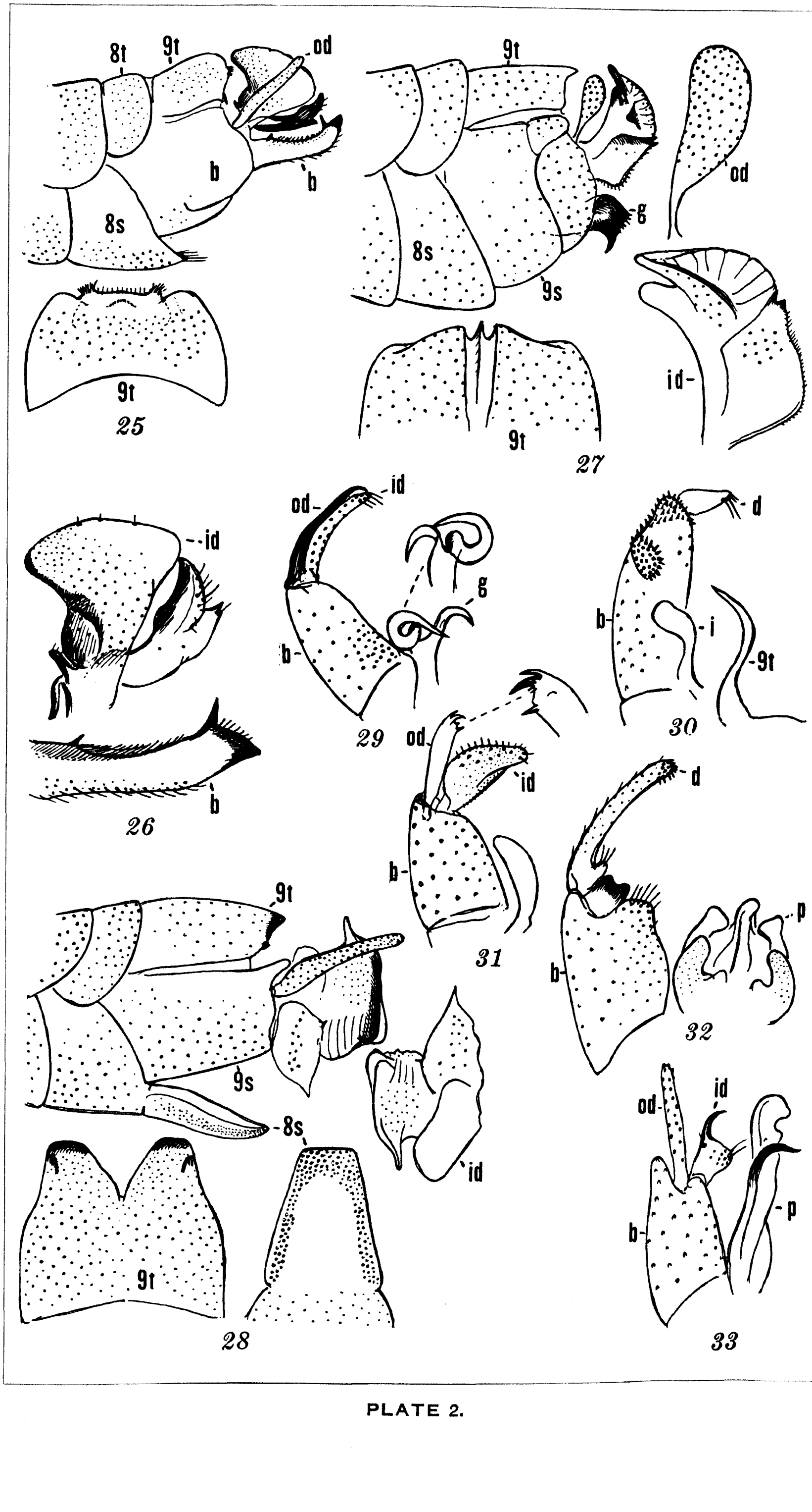
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PLATE 2.

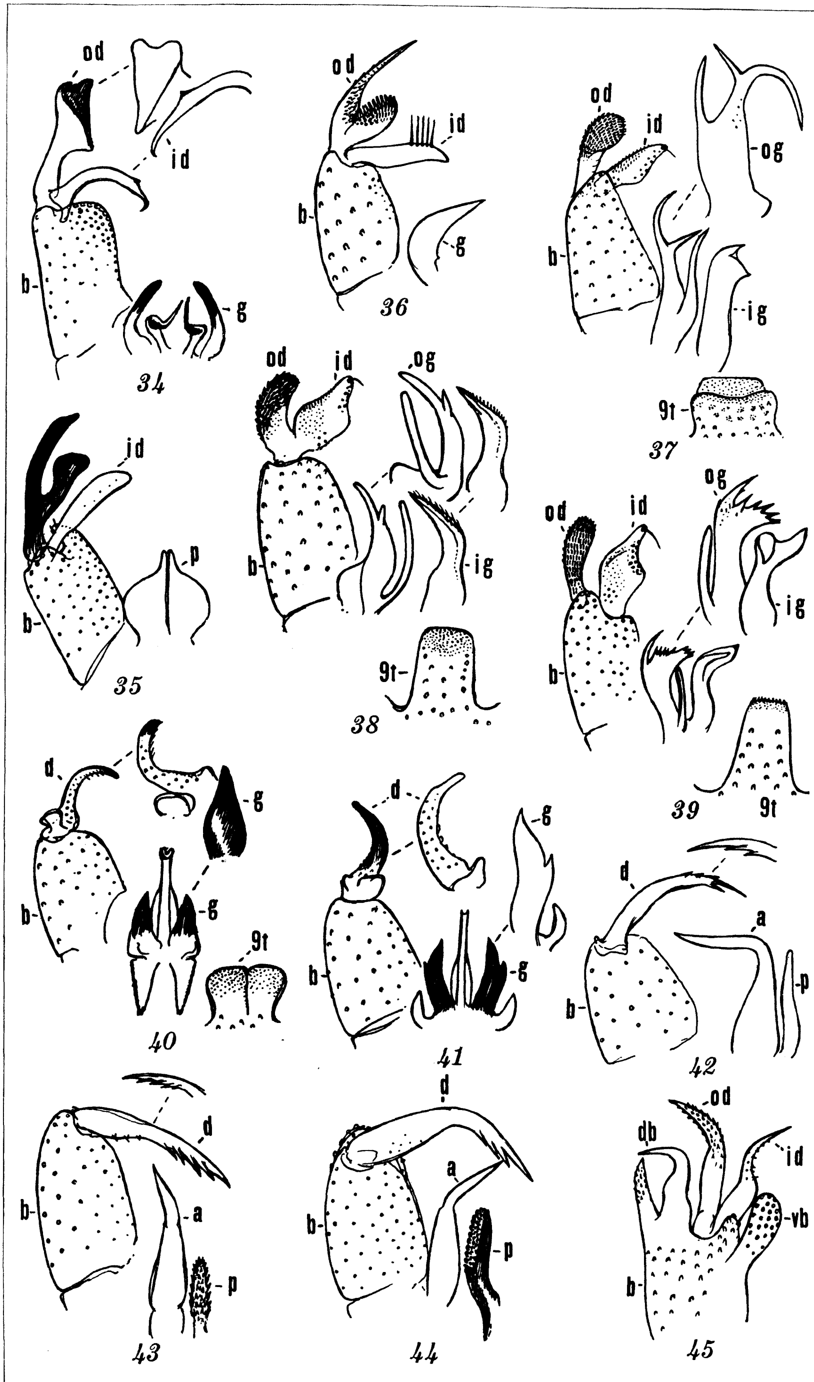
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PLATE 3.

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THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 60 JULY, 1936 No. 3

STUDIES IN THE APOCYNACEÆ, VI

By ROBERT E. WOODSON, Jr.

Of the Missouri Botanical Garden, Washington University, Saint Louis

ONE PLATE

KIBATALIA AND ITS IMMEDIATE GENERIC AFFINITIES

The taxonomy of flowering plants has long been distinguished by overwhelming respect for reproductive structures as indicators sine qua non of general relationship and phylogeny. It is not necessary to defend the use of floral characters in the definition of taxonomic entities: the success of such criteria amply justifies their employment. Within single large groups of flowering plants such as families, however, the use of reproductive structures occasionally resolves itself into quibbling comparisons of outline and insignificant variations from a general type idealized as "primitive" by successive writers of successively divergent viewpoints. This futility of approach has been particularly manifest in the efforts of certain students of the phylogeny of the flowering plants.

In the family Apocynaceæ the andrœcia are relatively complicated among flowering plants. The anthers and stigmata are particularly various. Only a bold investigator, in my opinion, can hope to perceive and to interpret rightly a plausible phylogenetic sequence in the intricate floral mechanism alone. Happily such reproductive variants are supported in the Apocynaceæ, and also in the closely related Asclepiadaceæ, by vegetative, chiefly foliar, characters, which clarify intrageneric relationships to a degree that has been little appreciated.

Such characters of the leaves include aggregations of small, fusiform glands found chiefly at the base, less commonly along

the entire length of the ventral surface of the midrib. The distribution of such foliar glands has been extremely useful in the recognition, in particular, of the two subgenera of the tropical American genus *Mandevilla*,[1] reënforcing the less easily observed floral characters. Such characters of the leaves also include peculiar superficial foveæ or pits of generally elliptic shape, which occur with greater or less regularity in the axils of the midrib and primary veins upon the dorsal, or lower, surface. Similar foveæ are infrequently found upon the lower surface of leaves of certain Rubiaceæ as well.

In the Apocynaceæ the foliar foveæ appear to be restricted to six genera: *Forsteronia* and *Tintinnabularia*, which are restricted to tropical America; *Kibatalia* and *Beaumontia*, of tropical Asia and Oceania; *Funtumia*, of Africa; and *Malouetia*, of western Africa and tropical America. The six genera are indubitably closely related, and all are members of the subfamily Echitoideæ. Employing the inclusion or relative degree of exsertion of the anthers as criteria for the erection of two tribes—Echitideæ and Parsonsieæ—within the Echitoideæ, Schumann [2] placed *Kibatalia* (as *Kickxia*) and *Beaumontia* within the Echitideæ, and *Forsteronia, Malouetia*, and *Vallaris* (predominantly composed of species referable to *Kibatalia*) within the Parsonsieæ, evidently expressing his view of their natural relationships. More recently Macfarlane [3] has indicated the genus *Vallaris* (vide ante) as derived phylogenetically from the genus *Wrightia; Funtumia* and *Malouetia* as direct lines from the prehistoric plexus of the subfamily Echitoideæ; *Kibatalia* (as *Kickxia*) as derived from *Funtumia; Forsteronia* as derived from *Secondatia* by way of *Thenardia;* and *Beaumontia* as derived from *Baissea*, together with numerous other discrepant genera. It should be observed that *Wrightia, Secondatia, Thenardia, Baissea*, and the genera associated by Macfarlane with *Beaumontia* are destitute of foliar foveæ.

The general aspect of the foliar foveæ has already been noted. The size and the shape vary somewhat among the genera and species demonstrating them (Plate 1, figs. 1–5). In a transverse section (Plate 1, fig. 6) the individual foveæ of *Funtumia elastica* (Preuss) Stapf is seen to be a rather shallow concavity with epidermal cells somewhat larger than those of the foliar epider-

[1] Cf. Woodson, Jr., R. E., Ann. Mo. Bot. Gard. 20 (1933) 613.

[2] In Engler and Prantl, Nat. Pflanzenfam. ed. 1 4 [2] (1895).

[3] The Evolution and Distribution of Flowering Plants. Chart 1. Philadelphia (1934).

mis proper. If secretion occurs, it must be relatively minor. Such histological relations have been found in leaf sections of several representative species of the genera *Malouetia, Forsteronia,* and *Funtumia.*

The emphasis upon the structure of the flower in treating of the taxonomy and phylogeny of the flowering plants has been based upon the general assumption that reproductive structures are more conservative than are vegetative structures. As a matter of fact, however, it would appear conversely that vegetative characters are too conservative to be used generally in plant classification; the variability of reproductive structures is more conducive to the recognition of taxonomic categories. Hence it is obvious why the larger divisions of the seed plants, as gymnosperms and angiosperms, monocotyledons and dicotyledons, find their surest foundations upon the anatomy of the root, the stem, and the leaf.

The foliar foveæ of the several genera of Echitoideæ, therefore, appear to be conspicuous, common, anatomical features. Having no evident function at present, they might also be interpreted as vestiges handed down from a common line of ancestors. Were the function of the foveæ obvious, it might be held with reason that they have been evolved independently in incongruent genera as a response to a common need. At any rate they furnish a convenient feature which helps to distinguish a group of genera common to both hemispheres, probably constituting evidence of relationship of the apocynaceous flora of either. Without further phylogenetic implications expressed, the several genera may be distinguished by means of the following:

Key to the foveate-leaved genera of Echitoideæ.

a^1. Seeds ecomose, glabrous or variously pubescent generally; leaves eglandular; shrubs and small trees; genus of tropical America and Africa .... *Malouetia.*

a^2. Seeds comose.

b^1. Coma chalazal, borne upon an elongate rostrum; leaves not glandular; trees.

c^1. Corolla salverform to infundibuliform, relatively delicate in texture; stamens exserted, or at least protruding into the inflated corolla throat; genus of tropical Asia and Oceania........ *Kibatalia.*

c^2. Corolla salverform, relatively fleshy in texture; stamens deeply included; genus of tropical Africa.......... *Funtumia.*

b^2. Coma micropylar, sessile; lianas.

c^1. Corolla infundibuliform, large and showy; staminal filaments much longer than the anthers.

d^1. Anthers without elongate, spirally contorted tips; leaves not glandular; genus of tropical Asia.......... *Beaumontia.*

d[3]. Anthers with elongate, spirally contorted tips; leaves glandular at the base of the midrib above; genus of Central America. *Tintinnabularia.*

c[3]. Corolla salverform, relatively small; staminal filaments shorter than the anthers or about as long; leaves mostly glandular at the base of the midrib above; genus of tropical America. *Forsteronia.*

The genera *Forsteronia* and *Malouetia,* the former wholly and the latter predominantly American, have already been revised in a previous number of these studies.[4] *Malouetia* has previously been represented in Africa by a single species, *M. Heudelotii* A. DC., of Sierra Leone and Senegal. Another species from the Belgian Congo may now be added.[5] *Tintinnabularia* is a re-

[4] Ann. Mo. Bot. Gard. 22 (1935) 153–244; 238–270.

[5] **MALOUETIA BEQUAERTIANA** Woodson **sp. nov.**

Arbuscula (fide Bequaert); ramulis teretibus glabris cortice rubro-brunneis inconspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice breviter acuteque subcaudato-acuminatis basi obtusis 7–19 cm longis 2.8–11 cm latis firmiter membranaceis glaberrimis supra subnitidulis subtus subglaucescentibus in axillis nervi medii inconspicue rareque foveatis; petiolis 0.3–0.6 cm longis; umbellis aut terminalibus aut lateralibus floras albidas 3–9 gerentibus; pedunculo 0.4–0.7 cm longo; pedicellis 1–1.5 cm longis glabris; calycis laciniis ovatis obtusis 0.2–0.25 cm longis valde imbricatis extus intusque papillatis margine minute ciliolatis; corollae salverformis tubo 1.8–2 cm longo basi ca. 0.15 cm diametro metiente paulo sub medio usque ad 0.4 cm diam. dilatato faucibus ampliatis ostio ca. 0.2 cm diametro metiente extus glaberrimo intus basi papillato prope insertionem staminum minute puberulis lobis oblique ovatis acute acuminatis 1.5–1.7 cm longis patentibus extus papillatis intus prope basem puberulis caeterumque puberulo-papillatis; antheris valde exsertis oblongo-ellipticis acutissime sagittatis 0.45 cm longis glaberrimis; ovario oblongo-ovoideo ca. 0.25 cm longo prope apicem minute puberulo-papillato; stigmate 0.2 cm longo; nectariis haud connatis ovario multo brevioribus; folliculis teretibus falcatis saepe subtorulosis 15–20 cm longis glabris; seminibus 2–2.5 cm longis sparse irregulariterque pilosulis.

BELGIAN CONGO, bords boisés de rivière, Stanleyville, February 25, 1915, *Bequaert 6967* (Herb. Jard. Bot. Bruxelles, *type,* Herb. Missouri Bot. Garden, photograph and analytical drawings); Yambuya, forêt, le long de l'eau, March 8, 1906, *Laurent 1023* (Bruxelles); Mondombu, date lacking, *Jespersen 188* (Bruxelles); Romée, February 19, 1906, *Laurent 958* (Bruxelles).

Malouetia Bequaertiana may be distinguished from *M. Heudelotii* as follows:

Corolla tube 1 to 1.2 cm long, not conspicuously inflated toward the base; lobes 1.5 to 1.7 cm long, papillate without, generally puberulent to puberulent-papillate within; plants of the Belgian Congo.... *M. Bequaertiana.*

Corolla tube 1 to 1.2 cm long, not conspicuously inflated toward the base; the lobes 0.8 to 0.9 cm long, glabrous without, minutely puberulent at the very base within, otherwise glabrous; plants of Senegal and Sierra Leone .... *M. Heudelotii.*

cently discovered monotypic genus of Guatemala.[6] *Funtumia* and *Beaumontia,* consisting of relatively few species of tropical Africa and Asia, respectively, have not yet been the cause of taxonomic difficulties. The situation of *Kibatalia,* however, has been singularly confusing and deserves a somewhat extended revision even upon the imperfect basis of our present knowledge of the tropical Asiatic flora.

Genus KIBATALIA G. Don, char. emend.

Kibatalia G. DON, Gen. Syst. 4 (1838) 86; MERR., Philip. Journ. Sci. 17 (1920) 306.

Hasseltia BLUME, Bijdr. (1826) 1045, non HBK.

Kixia BLUME, Fl. Jav. Praef. 1 (1828) 7; A. DC. in DC., Prodr. 8 (1844) 408, err. typ.

Kickxia BLUME, Rumphia 4 (1848) 25; K. SCH. in Engler and Prantl, Nat. Pflanzenfam. 4 ² (1895) 174, non Dum.

Paravallaris PIERRE, Bull. Soc. Linn. Paris n. s. 1 (1898) 30.

Vallaris Auct., pro parte, non Burm. f.

Lactescent shrubs or trees. Stems ligneous, terete or somewhat compressed; branches opposite or alternate. Leaves opposite, the dorsal surface bearing with more or less frequency a single lenticular or pustulate fovea or pit in the axils of the midrib and secondary veins; nodes inconspicuously stipulate. Inflorescence alternate-lateral or subterminal, rarely terminal, subumbellate, few- to several-flowered. Calyx 5-parted, the lobes essentially equal, cleft nearly to the receptacle, bearing within alternate solitary or clustered squamellæ. Corolla infundibuliform to salverform, the tube cylindrical to narrowly conical, exappendiculate within, the limb actinomorphic, 5-parted, dextrorsely convolute. Stamens 5, the anthers usually more or less exserted, at least protruding conspicuously into the inflated corolla throat, connivent and agglutinated to the stigma, consisting of 2 parallel sporangia borne ventrally near the base of an enlarged, acutely sagittate, peltate connective; pollen granular; filaments free, somewhat shorter than the anther, bearing dorsally near the apex a more or less conspicuous, callose gland. Carpels 2, apocarpous, united at the apex by a common stylar shaft surmounted by the fusiform-subcapitate stigma; ovules numerous, borne upon an axile, binate placenta. Nectaries 5, separate or more or less concrescent. Follicles 2, apocarpous or persistently united at the tips, dehiscing along the ventral suture; containing numerous dry seeds provided with a rostrate, chalazal coma.

[6] Woodson, Jr., R. E., Ann. Mo. Bot. Gard. 23 (1936) 387.

Type species: *Kibatalia arborea* (Blume) G. Don, Gen. Syst. 2 (1838) 86.

The name *Kibatalia* was restored to use in 1920 by Merrill,[7] who assigned appropriate new combinations for most of the valid species previously placed in *Kickxia*, both Asiatic and African, evidently unaware that the latter had previously been taken to constitute the genus *Funtumia* Stapf.

To the Asiatic species of *Kibatalia* have here been added certain species previously relegated to *Vallaris* Burm. f. which show important divergences from the type species of that genus, *V. pergulana* Burm. f., such as the erect fruticose or arboreal habit, the foveate leaves, the subumbellate inflorescence, the rostrate seeds, and structural details of the reproductive organs, all of which are conformable to the generic limits of *Kibatalia*. *Vallaris lancifolia* Hook. f. has been found to constitute a third generic element, which will be discussed elsewhere.

Key to the species of Kibatalia.

Subgenus I. PARAVALLARIS (Pierre) Woodson

Paravallaris PIERRE, Bull. Soc. Linn. Paris n. s. 1 (1898) 30, pro gen.

Corolla salverform, relatively small; anthers conspicuously exserted.

a[1]. Follicles relatively stout and rigid; species of southeastern continental Asia and Sumatra.
  b[1]. Squamellæ solitary, occasionally deeply cleft, alternate with the calyx lobes.
    c[1]. Corolla 1.5 to 2 cm long; staminal gland extremely inconspicuous.
      d[1]. Peduncles about equaling the subtending petioles; corolla 1.9 to 2 cm long, the lobes oblong-ovate, densely puberulent within; plants of Siam .... 1. *K. laurifolia*.
      d[2]. Peduncles much shorter than the subtending leaves; corolla 1.5 to 1.8 cm long, the lobes puberulent-papillate within; plants of the Malay Peninsula and Sumatra........ 2. *K. Maingayi*.
    c[2]. Corolla 2.5 to 2.8 cm long; staminal gland conspicuous; species of Indo-China.
      d[1]. Leaves coriaceous, 6 to 14 cm long, the foveæ very conspicuous; anthers minutely pilosulose dorsally........ 3. *K. microphylla*.
      d[2]. Leaves firmly membranaceous; 17 to 20 cm long, the foveæ inconspicuous; anthers essentially glabrous dorsally. 4. *K. macrophylla*.

[7] Philip. Journ. Sci. 17 (1920) 306.

b^2. Squamellæ numerous, indefinitely distributed; corolla 2.9 to 3.1 cm long; staminal gland conspicuous; plants of Burma.
5. *K. anceps.*

a^2. Follicles relatively slender and flexuous; species of the Philippine Islands.

b^1. Leaves elliptic-lanceolate, usually narrowly so; floral buds glabrous or indefinitely papillate at the tips; corolla lobes puberulent-papillate within .... 6. *K. gitingensis.*

b^2. Leaves elliptic; floral buds puberulent-papillate at the tips; corolla lobes densely puberulent within .... 7. *K. daronensis.*

Subgenus II. EUKIBATALIA Woodson subgen. nov.

Corolla infundibuliform to subinfundibuliform, relatively large and showy; anthers protruding into the inflated corolla throat or slightly exserted beyond the orifice.

a^1. Corolla relatively small, 3 to 3.5 cm long; species of the Philippine Islands.

b^1. Corolla tube somewhat less than 0.1 cm in diameter at the base; leaves membranaceous, elliptic-lanceolate, 2 to 2.5 cm broad.
8. *K. luzonensis.*

b^2. Corolla tube 0.2 cm in diameter at the base; leaves coriaceous, obovate-elliptic, 3 to 3.5 cm broad .... 9. *K. stenopetala.*

a^2. Corolla relatively large, 5 to 8 cm long.

b^1. Squamellæ solitary, occasionally deeply cleft, alternate with the calyx lobes.

c^1. Nectaries thick and fleshy, shorter than the ovary.

d^1. Inflorescence several- (usually 4- to 8-) flowered; plants of Borneo .... 10. *K. borneensis.*

d^2. Inflorescence few- (usually 1- or 2-) flowered; plants of the Philippine Islands.

e^1. Corolla throat about equaling the proper tube.

f^1. Leaves rather narrowly oblong, coriaceous or subcoriaceous.

g^1. Corolla 7 to 8 cm long, the proper tube rather gradually constricted at the insertion of the stamens, the throat 1.3 to 1.5 cm long .... 11. *K. Merrittii.*

g^2. Corolla 5 to 6 cm long, the proper tube abruptly constricted at the insertion of the stamens, the throat 0.6 to 0.7 cm long .... 12. *K. Blancoi.*

f^2. Leaves broadly elliptic, rather delicately membranaceous; corolla 7 to 7.5 cm long, the proper tube rather gradually constricted at the insertion of the stamens, the throat 0.8 to 1 cm long .... 13. *K. puberula.*

e^2. Corolla throat much shorter than the proper tube.

f^1. Corolla throat much wider than the proper tube, 0.7 to 0.9 cm in diameter, the lobes broadly obtuse to rounded.
14. *K. Elmeri.*

f[2]. Corolla throat scarcely wider than the proper tube, 0.4 to 0.5 cm in diameter, the lobes acute............ 15. *K. Macgregorii.*

c[2]. Nectaries delicately membranaceous, completely concealing the ovary; corolla throat much shorter than the proper tube; plants of the Philippine Islands.. 16. *K. Merrilliana.*

b[2]. Squamellæ numerous, indefinitely distributed.

c[1]. Leaves lanceolate to oblong-lanceolate, rarely oblong, coriaceous; corolla lobes about 7 cm long; plants of Celebes. 17. *K. Wigmani.*

c[2]. Leaves ovate to broadly elliptic, membranaceous; corolla lobes 3.5 to 4 cm long; plants of Java.................................... 18. *K. arborea.*

The two subgenera are clearly congeneric, as the somewhat slight discrepancy in the size of the flowers and the relative depth of insertion of the stamens are apparently the chief, if not the sole, basis of their distinction.

Through the kindness of the curators I have been privileged to examine critical specimens of *Kibatalia* from several of the leading herbaria of the United States, Europe, and Asia, which are cited by means of the following parenthetical abbreviations: Bureau of Science, Manila, Philippine Islands (BSM); Royal Botanic Gardens, Kew, England (K); Missouri Botanical Garden, Saint Louis, U. S. A. (MBG); Museum National de l'Histoire Naturelle, Paris, R. F. (MP); New York Botanical Garden, New York City, U. S. A. (NY); United States National Herbarium, Washington, U. S. A. (US).

1. KIBATALIA LAURIFOLIA (Ridl.) Woodson.

Kibatalia laurifolia (Ridl.) WOODSON, Sunyatsenia 3 (1936) 102.

Trachelospermum laurifolium RIDL., Journ. Fed. Malay States Mus. 5 (1915) 163.

Shrubs (according to Ridley); stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves oblong-elliptic, apex shortly acuminate, base obtuse, 8 to 15 cm long, 2 to 4 cm broad, coriaceous to subcoriaceous, wholly glabrous, lustrous above, opaque beneath; petioles 0.2 to 0.4 cm long; inflorescence 5- to 8-flowered; peduncle about equaling the subtending petioles, essentially glabrous; pedicels 0.6 to 0.8 cm long, very indefinitely papillate to essentially glabrous; calyx lobes broadly ovate, obtuse, 0.2 to 0.25 cm long, very minutely puberulent-papillate to essentially glabrous, the squamellæ solitary, ovate, entire; corolla yellowish (according to Ridley), salverform, the tube flaskform, about 1 cm long, about 0.13 cm in diameter at the base, above which slightly inflated to about 0.2 to slightly above midway, thence gradually narrowed, about 0.12 cm in diameter at the short faucal tube, glabrous without,

puberulent-papillate within towards the insertion of the stamens, the lobes obliquely oblong-ovate, acute to acuminate, 0.9 to 1 cm long, papillate without, densely puberulent within, sharply spreading; anthers conspicuously exserted, 0.25 cm long, minutely hirtellous dorsally, the gland scarcely manifest; ovary ovoid, about 0.1 cm long, minutely puberulent-papillate; stigma 0.07 cm long; nectaries subreniform, essentially separate, less than half equaling the ovary; follicles unknown.

SIAM, Koh Pennan, *Robinson 5764*, 1914 (MP, isotype, MBG, photograph and analytical drawings).

2. KIBATALIA MAINGAYI (Hook. f.) Woodson comb. nov.

Vallaris Maingayi HOOK. F., Fl. Brit. Ind. 3 (1882) 651.

Large trees (according to Maingay); stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves rather broadly elliptic, rarely to broadly oblong-elliptic, apex obtusely subcaudate-acuminate, base obtuse to broadly acute, 6 to 13 cm long, 2 to 5.5 cm broad, coriaceous to subcoriaceous, glabrous throughout; petioles 0.4 to 0.5 cm long; inflorescence 3- to 10-flowered; peduncle scarcely manifest, much shorter than the subtending petioles, glabrous; pedicels 0.5 to 0.8 cm long, glabrous; calyx lobes ovate, acute, 0.18 to 0.2 cm long, papillate without, the squamellæ solitary and alternate with the calyx lobes, ovate-quadrate, entire to minutely lacerate; corolla white (according to Hooker), salverform, the tube cylindric-flaskform, 0.65 to 0.8 cm long, about 0.15 to 0.2 cm in diameter at the base, slightly narrowing toward the insertion of the stamens, essentially glabrous without, within puberulent towards the insertion of the stamens, otherwise puberulent-papillate, the lobes obliquely ovate, obtuse to shortly acute, 0.9 to 1.1 cm long, puberulent-papillate without and within, reflexed or sharply spreading; anthers conspicuously exserted, 0.25 to 0.3 cm long, minutely barbellate towards the tip, the gland very inconspicuous; ovary oblong-ovoid, about 0.15 cm long, minutely puberulent; nectaries deeply 5-lobed, essentially concrescent, somewhat shorter than the ovary; follicles relatively stout and rigid, 22 to 28 cm long, about 0.4 to 0.7 cm in diameter, sharply divaricate, acuminate, glabrous; seeds 4 to 4.5 cm long, the rostrum about equaling the length of the seed, the pale yellow coma 5.5 to 6 cm long.

Malaya. JOHORE, Penyabong, *Foxworthy 1174*, May, 1918 (BSM). PENANG, Batu Feringy, *Curtis 12569*, 1897 (BSM). SINGAPORE, *Ridley 4917*, garden jungle, 1893 (BSM); same lo-

cality, *Curtis s. n.*, 1905 (BSM, MBG); data incomplete, *Gandoger s. n.*, July, 1906 (MBG).

SUMATRA, Loendoet Concession, Koealoe, *Bartlett 7124*, March 31, 1927 (NY).

3. KIBATALIA MICROPHYLLA (Pitard) Woodson comb. nov.

Paravallaris microphylla PITARD, in Lecomte, Fl. Gén. Indo-Chine 3 (1933) 1181.

Small trees, 5 to 10 m tall (according to Pitard); stems relatively stout, glabrous, very inconspicuously lenticellate when fully mature; leaves oblong-elliptic, apex obtusely acute to very shortly and obtusely acuminate, base obtuse to acute, 6 to 14 cm long, 2 to 5 cm broad, rather heavily coriaceous, wholly glabrous; petioles 0.3 to 0.5 cm long; inflorescence 3- to 5-flowered; peduncle somewhat shorter than the subtending leaves, glabrous; pedicels 0.7 to 1 cm long, glabrous; calyx lobes broadly oval, obtuse, minutely puberulent-papillate without, 0.3 to 0.35 cm long, the squamellæ solitary and alternate with the calyx lobes, entire or essentially so; corolla salverform, white (according to Pitard), the tube cylindric-flaskform, 1.2 to 1.3 cm long, about 0.2 to 0.225 cm in diameter at the base, constricting to about 0.15 cm in diameter at the orifice, essentially glabrous without, puberulent towards the insertion of the stamens within, the lobes obliquely obovate-elliptic, obtuse, 1.3 to 1.4 cm long, minutely papillate without, minutely puberulent within, reflexed or sharply spreading; anthers conspicuously exserted, 0.3 cm long, minutely pilosulose dorsally, the gland obscurely binate, subreniform; ovary ovoid, about 0.1 cm long, minutely puberulent; nectaries concrescent, indefinitely lobed, about one-third equaling the ovary; immature follicles relatively stout and rigid, obtuse, essentially glabrous; seeds unknown.

French Indo-China. ANNAM, Nha-trang Province, Hoa-tan, *Poilane 47*, June 23, 1919 (MP, type, NY, MBG, photograph); Phu-hu, *Poilane S423*, January 22, 1923 (MP, NY); Tourane and vicinity, forest, *Clemens and Clemens 4344*, May to July, 1927 (MBG, NY, US).

4. KIBATALIA MACROPHYLLA (Pierre) Woodson comb. nov.

Paravallaris macrophylla PIERRE, in Planch., Prod. Apocyn. (1894) 325; PITARD, in Lecomte, Fl. Gén. Indo-Chine 3 (1933) 1180.

Shrubs, 2 to 6 m tall (according to Pitard); stems relatively stout, glabrous, conspicuously lenticellate when fully mature; leaves broadly oblong-elliptic, apex very shortly and obtusely

subcaudate-acuminate, base obtuse, 17 to 20 cm long, 4 to 9 cm broad, firmly membranaceous, minutely puberulent-papillate beneath when very young, wholly glabrous when fully mature; petioles 0.5 to 0.7 cm long; inflorescence 4- to 10-flowered; peduncle somewhat shorter than the subtending petioles, essentially glabrous; pedicels 0.8 to 1.1 cm long, essentially glabrous to very minutely and irregularly pilosulose; calyx lobes ovate, broadly acute to obtuse, 0.3 to 0.35 cm long, puberulent-papillate without, the squamellæ solitary and alternate with the calyx lobes, more or less irregularly lacerate and divided; corolla salverform, yellowish white (according to Pitard), the tube cylindric-flaskform, 1 to 1.2 cm long, about 0.3 cm in diameter at the base, constricting to about 0.15 cm in diameter at the orifice, essentially glabrous without, minutely puberulent within towards the insertion of the stamens, the lobes obliquely oblong-elliptic, acuminate, 1.5 to 1.6 cm long, minutely puberulent-papillate without, densely and minutely puberulent within, reflexed or sharply spreading; anthers conspicuously exserted, 0.3 to 0.325 cm long, essentially glabrous dorsally, the gland conspicuous, binate-ovoid; ovary ovoid-oblongoid, about 0.15 cm long, minutely puberulent; nectaries concrescent, irregularly lobed, about half equaling the ovary; follicles relatively stout and rigid, 8 to 17 cm long, about 0.6 to 0.8 cm in diameter, divaricate, obtusish, glabrous; seeds 1.5 to 2 cm long, the rostrum 3 to 3.5 cm long, the very pale yellowish or white coma 5 to 5.5 cm long.

French Indo-China. ANNAM, Thanth-Hoa Province, Hoi-Xuan, *Poilane 1752*, August 17, 1920 (MP, NY); Vinh-Yen Province, *Eberhardt 3801*, no date (MP, NY); Tuyen Quang, *Petelot 1934*, June, 1925 (NY); Hoa Binh Province, route de Hoa Binh, *Petelot 4921*, January, 1931 (NY).

Although the foliage appears to conform, the follicles of *Petelot 4921* are much smaller than those of *Poilane 1752* and evidently somewhat more compressed as well.

5. **KIBATALIA ANCEPS (Dunn and R. Williams) Woodson.**

Kibatalia anceps (Dunn and R. Williams) WOODSON, Sunyatsenia 3 (1936) 101.

Vallaris ? anceps WALL., Cat. (1828) No. 1622, nom. nud.

Trachelospermum anceps DUNN and R. WILLIAMS, Kew Bull. (1920) 343.

Vallaris arborea FISCHER, Kew Bull. (1927) 92.

Vallaris anceps (Dunn and R. Williams) FISCHER, Kew Bull. (1931) 28 [where cited as *V. anceps* (Wall.) Fischer].

Trees (small, according to Dunn and R. Williams; 40 feet tall, according to Fischer); stems relatively stout, minutely puberulent when young, eventually becoming glabrate; leaves oblong-elliptic, apex shortly acuminate, base obtuse, 15 to 25 cm long, 4.5 to 8.5 cm broad, subcoriaceous, rather lustrous and glabrous above, opaque and densely puberulent beneath; petioles 1 to 1.2 cm long, minutely puberulent to glabrate; inflorescence 5- to 8-flowered; peduncle about equaling the subtending petiole, minutely puberulent; pedicels 1.8 to 2 cm long, minutely puberulent; calyx lobes ovate, obtuse, 0.4 to 0.5 cm long, minutely and densely puberulent without, the squamellæ numerous, regularly and indefinitely distributed; corolla salverform, essentially glabrous to very indefinitely papillate without, the tube somewhat conical, 1.2 to 1.3 cm long, about 0.6 cm in diameter at the base, and 0.2 cm in diameter at the orifice, puberulent within above, the lobes obliquely ovate, obtuse, 1.7 to 1.8 cm long, about 1 cm broad, very minutely papillate without, puberulent-papillate within, sharply spreading; anthers 0.35 cm long, conspicuously exserted, minutely hirtellous dorsallly, the gland subreniform, entire, about one-fifth equaling the anther; ovary broadly ovoid, about 0.15 cm tall, puberulent-papillate; stigma fusiform, 0.15 cm long; nectaries somewhat concrescent, nearly equaling the ovary; follicles relatively stout, 15 to 19 cm long, about 1 cm in diameter, glabrous, sharply divaricate; seeds about 5 to 2 cm long, the slender rostrum slightly surpassing the region of the embryo, the pale tawny coma about 6 cm long.

INDIA, Burma, South Tenasserim, Ngawun Chaung forests, altitude 300 feet, *Parkinson 1632,* January 26, 1926 (K, MBG, photograph); Letpanthaung, *Meebold 14654,* March, 1911 (K, cotype).

6. KIBATALIA GITINGENSIS (Elm.) Woodson comb. nov.

Kickxia gitingense ELM., Leafl. Philip. Bot. 4 (1912) 1455.
Vallaris angustifolia MERR., Philip. Journ. Sci. 7 (1912) 335.
Vallaris gitingensis (Elm.) MERR., Philip. Journ. Sci. 10 (1915) 70.

Trees, 5 to 20 m tall (according to collectors); stems relatively slender, glabrous, very inconspicuously lenticellate when fully mature; leaves elliptic-lanceolate, usually very narrowly so, apex obtusely subcaudate-acuminate, base acute to attenuate, 3 to 12 cm long, 1 to 3 cm broad, subcoriaceous, glabrous throughout; petioles 0.2 to 0.5 cm long; inflorescence 4- to 12-flowered; peduncle somewhat shorter than the subtending petioles, gla-

brous; pedicels 0.5 to 1 cm long, glabrous; calyx lobes ovate, acute to obtuse, minutely papillate to puberulent-papillate without, the squamellæ solitary, alternate, dentiform, very inconspicuous; corolla salverform, creamy white (according to Elmer), the tube flaskform, 0.6 to 0.8 cm long, about 0.15 cm in diameter at the base, somewhat inflated towards midway, thence gradually constricted, about 0.1 to 0.125 cm in diameter at the orifice, glabrous without, minutely puberulent towards the insertion of the stamens within, the lobes obliquely ovate-elliptic, obtuse to broadly acuminate, 0.7 to 1.2 cm long, minutely papillate to essentially glabrous without, minutely puberulent to puberulent-papillate within, reflexed to sharply spreading; anthers conspicuously exserted, 0.2 to 0.25 cm long, essentially glabrous dorsally, the gland conspicuous, ovoid-subreniform; ovary ovoid, about 0.1 cm long, puberulent to puberulent-papillate; nectaries distinctly 5-cleft, about equaling to about half equaling the ovary; follicles relatively slender and flexuous, long-acuminate, 11 to 25 cm long, about 0.25 to 0.4 cm in diameter, divaricate to falcate, glabrous; seeds 1.5 to 2 cm long, the rostrum 4 to 5 cm long, the pale tawny coma 5 to 7 cm long.

Philippine Islands. LUZON, Laguna Province, *F. B.*[8] *22503 Mariano,* February and March, 1911 (BSM), *Manuel* (BSM): Camarines Sur Province, Agosais, *Bur. Sci. 76127 Edaño,* on slope in damp forest, altitude 1,500 feet, October, 1928 (BSM, NY); Guinobatan, *F. B. 27241 Palma,* July, 1918 (BSM): Camarines Norte Province, Paracale, *Bur. Sci. 33515 Ramos and Edaño,* damp forests, November and December, 1918 (BSM, US): Ilocos Norte Province, Burgos, *Bur. Sci. 32908 Ramos,* dry thickets, July, 1918 (BSM): Tayabas Province, Mauban, San Jose, Bia-an, on the mountain ridges where the soil is deep and loose, altitude 400 meters, *F. B. 25565 Duldulao,* May, 1916 (BSM, US); Lucban, Mount Banahao, mountain forest, altitude 2,000 meters, *Bur. Sci. 19537 Ramos,* January 31, 1913 (BSM, US): Sorsogon Province, Irosin, Mount Bulusan, *Elmer 15910,* April, 1916 (BSM, MBG, NY); Mount Pocdol, altitude 130 meters, damp forests, *Bur. Sci. 23434 Ramos,* July and August, 1915 (BSM, MBG, NY, US). CATANDUANES, Barrio Agbau, *F. B. 28829 Borja,* January 19, 1922. SIBUYAN, Magallanes, Mount Giting-Giting, *Elmer 12203* (MBG, NY, US, isotypes). LEYTE,

[8] *F. B.*, Bureau of Forestry, or *Bur. Sci.*, Bureau of Science, is followed by Bureau of Science herbarium number and the collector's name.

Buenavista, forest, altitude 500 meters, *Wenzel 678,* May 15, 1914 (BSM). MINDANAO, Surigao Province, *Wenzel 2554,* June 26, 1924 (BSM, MBG, NY).

7. **KIBATALIA DARONENSIS (Elm.) Woodson comb. nov.**

Holarrhena daronensis ELM., Leafl. Philip. Bot. 4 (1912) 1455.
Vallaris daronensis (Elm.) MERR., Philip. Journ. Sci. 10 (1915) 70.

Trees, 5 to 20 m tall (according to collectors); stems relatively slender, glabrous, rather inconspicuously lenticellate when fully mature; leaves elliptic, apex shortly and obtusely subcaudate-acuminate, base acute to obtuse, 4 to 10 cm long, 1.5 to 4 cm broad, subcoriaceous, glabrous throughout; petioles 0.4 to 0.6 cm long; inflorescence 3- to 7-flowered; peduncles somewhat shorter than the subtending leaves, glabrous; pedicels 0.4 to 0.6 cm long, glabrous; calyx lobes ovate, obtuse, 0.25 to 0.3 cm long, indistinctly papillate without, the squamellæ alternate with the calyx lobes, solitary; corolla salverform, white (according to Elmer), the tube (in buds shortly before anthesis) cylindric-flaskform, 0.6 to 0.7 cm long, about 0.1 cm in diameter at the base, gradually narrowing to about 0.07 cm in diameter at the orifice, essentially glabrous without, minutely puberulent at the attachment of the stamens within, the lobes obliquely elliptic-ovate, acute, 0.7 to 0.8 cm long, minutely puberulent-papillate without, densely puberulent within, reflexed or sharply spreading; anthers conspicuously exserted, 0.25 cm long, minutely barbellate at the tips, the gland narrowly subreniform, relatively conspicuous; ovary ovoid-oblongoid, about 0.1 cm long, minutely and sparsely pilosulose; nectaries concrescent, irregularly 5-lobed, about half equaling the ovary; follicles relatively slender and flexuous, long-acuminate, 25 to 40 cm long, about 0.35 to 0.5 cm in diameter, divaricate to falcate, glabrous; seeds about 2 cm long, the rostrum 2.5 to 3 cm long, the very pale tawny coma 6 to 8 cm long.

Philippine Islands. MINDANAO, Davao District, Mount Apo, *Elmer 11912,* October, 1909 (MBG, NY, isotypes): Agusan Province, So. Vitus, along Vitus Creek, *F. B. 31308 Genove,* July 19, 1927 (BSM): Lanao Province, Lake Lanao, at base of wooded hill, *Clemens s. n.,* May, 1907 (BSM): Misamis Province, *Quadras s. n.,* no date (BSM).

8. **KIBATALIA LUZONENSIS Woodson sp. nov.**

Arborea ut dicitur alt. 10 m attingens; ramulis gracilibus omnino glaberrimis maturitate obscure lenticellatis; foliis breviter

petiolatis elliptico-lanceolatis apice obtuse subcaudato-acuminatis basi acutis obtusisve 6–9 cm longis 1.5–2.5 cm latis membranaceis omnino glaberrimis; petiolis 0.4–0.5 cm longis; inflorescentiis 1- (2-) floris; pedunculo subnullo; pedicellis 0.8–1 cm longis, glaberrimis; calycis laciniis late ovatis obtusis, 0.25–0.3 cm longis, glabris squamellis solitariis alternatis irregulariter laciniatis; corollae salverformis ut dicitur albidae tubo cylindrico 1–1.1 cm longo basi ca. 0.08 cm diametro metiente faucibus paululo ampliatis ca. 0.1 cm diametro metientibus extus glaberrimo intus prope insertionem staminum minute puberulo lobis oblique lineariellipticis acuminatis 2.5–2.7 cm longis, 0.2–0.3 cm latis intus basi puberulo-papillatis caeterumque glabriusculis; antheris in corollae faucibus inclusis 0.4–0.425 cm longis minute sparseque barbellatis glandula integra valde manifesta; ovario ovoideo-oblongoideo ca. 0.1 cm longo, glabro; nectariis concrescentibus regulariter 5-lobatis ovario subaequantibus; foliculis ignotis.

Philippine Islands. LUZON, Laguna Province, Majayjay, in virgin forest, altitude 3,000 feet, *Bur. Sci. 75041 Rivera and Duyag*, June 20, 1928 (BSM, type, MBG, photograph and analytical drawings).

9. **KIBATALIA STENOPETALA** Merr.

Kibatalia stenopetala MERR., Philip. Journ. Sci. 17 (1920) 308.

Small trees 5 m tall (according to Merrill); stems relatively slender, glabrous, inconspicuously lenticellate when fully mature; leaves obovate-elliptic, apex obtuse to very shortly and obtusely subcaudate-acuminate, base obtusely to acutely cuneate, 6 to 9 cm long, 2 to 3.5 cm broad, rather heavily coriaceous, wholly glabrous; petioles 0.4 to 0.5 cm long; inflorescence 1- or 2-flowered; peduncle somewhat shorter than the subtending petioles, glabrous; pedicels 1.7 to 2 cm long, glabrous, calyx lobes broadly ovate, obtuse, 0.15 to 0.2 cm long, essentially glabrous without the squamellæ, solitary, subentire, alternate with the calyx lobes; corolla subinfundibuliform, white (according to Merrill), the tube (sensu latiore) 0.9 to 1 cm long, about 0.2 to 0.225 cm in diameter at the base, somewhat inflated above the insertion of the stamens, about 0.25 cm in diameter at the orifice, essentially glabrous without, minutely puberulent above the insertion of the stamens within, the lobes obliquely linear-elliptic, acuminate, 2 to 2.3 cm long, 0.3 to 0.4 cm broad, spreading, essentially glabrous without minutely puberulent towards the base within; anthers inserted at about the lower third of the corolla tube (sensu latiore), 0.55 to 0.6 cm long, sparsely and very minutely

barbellate, the gland compressed-ovoid, relatively conspicuous; ovary ovoid, about 0.15 cm long, very sparsely and irregularly pilosulose; nectaries concrescent, indefinitely and irregularly lobed, sparsely and irregularly ciliate, about half equaling the ovary; follicles unknown.

Philippine Islands. MINDANAO, Surigao Province, along streams at low altitudes at the iron deposit on the northeast coast, *Bur. Sci. 34691 Ramos and Pascasio*, June 14, 1919 (US, isotype, MBG, photograph and analytical drawings).

10. KIBATALIA BORNEENSIS (Stapf) Merr.

Kibatalia borneensis (Stapf) MERR., Philip. Journ. Sci. 17 (1920) 309.

Kickxia borneensis STAPF, in Hook., Ic. 27 (1901) *pl. 2693.*

Shrubs (about 18 dm tall according to Stapf); branches relatively stout, glabrous, leaves opposite, shortly petiolate, oblong-elliptic, apex shortly and obtusely subcaudate-acuminate, base obtuse, 10 to 15 cm long, 3 to 4.5 cm broad, coriaceous, glabrous, nitidulous above, opaque beneath; petioles 0.4 to 0.5 cm long, glabrous; inflorescence lateral, alternate, subumbellate, bearing 4 to 8 rather showy flowers; peduncle shorter than the subtending petioles, glabrous; pedicels 0.3 to 0.4 cm long, glabrous, greatly accrescent in fruit; bracts extremely inconspicuous; calyx lobes ovate-elliptic, acute, 0.3 to 0.4 cm long, slightly foliaceous, glabrous or essentially so, the squamellæ solitary, alternate; corolla infundibuliform, glabrous without, the proper tube 1.5 cm long, about 0.2 cm in diameter at the base, the throat conical-campanulate, 1.3 cm long, about 0.6 cm in diameter at the orifice, the lobes obliquely oblong-dolabriform, obtuse, 1.5 cm long, slightly spreading; stamens inserted at the base of the corolla throat, the anthers elliptic, 0.6 cm long, essentially included, glabrous; ovary oblong-ovoid, about 0.2 cm long, glabrous; nectaries about half equaling the ovary; stigma 0.1 long; follicles relatively stout, 14 to 15 cm long, glabrous without; seeds unknown.

BORNEO, Sarawak, data incomplete, *Lobb s. n.* (K, type, MBG, photograph).

11. KIBATALIA MERRITTII (Merr.) Woodson comb. nov.

Kickxia Merrittii MERR., Philip. Journ. Sci. 4 (1909) 315.

Trees, 15 m tall (according to collectors); stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves oblong-elliptic, apex obtuse to very shortly and

obtusely subcaudate-acuminate, base obtuse to acute, 6 to 10 cm long, 1.3 to 3 cm broad, firmly membranaceous, glabrous throughout; petioles 0.5 to 0.8 cm long; inflorescence 1- or 2-flowered; peduncle scarcely manifest; pedicels 1.5 to 1.7 cm long, glabrous, calyx lobes ovate, obtuse, papillate without, 0.4 to 0.45 cm long, the squamellæ alternate, solitary; corolla infundibuliform, white (according to collectors), the proper tube 1.2 to 1.5 cm long, about 0.6 cm in diameter at both base and orifice, glabrous without and within, the throat cylindric, 1.5 to 1.7 cm long, about 0.8 cm in diameter at the orifice, indefinitely papillate to essentially glabrous without, minutely puberulent-papillate within, puberulent at the insertion of the stamens, the lobes obliquely elliptic, acute to acuminate, 4.5 to 5 cm long, 1.3 to 1.5 cm broad, essentially glabrous; anthers 0.6 to 0.65 cm long, glabrous dorsally, or very minutely and sparsely barbellate, the gland compressed-ovoid, fairly conspicuous; ovary ovoid, about 0.2 cm long, very minutely pilosulose to glabrous; nectaries concrescent, essentially entire, about half equaling the ovary; follicles unknown.

Philippine Islands. LUZON, Cagayan Province, Raron, altitude 100 meters, *F. B. 26678 Peñas,* May 17, 1917 (BSM). MINDORO, data incomplete, *F. B. 11488 Merritt,* April and May, 1908 (US, isotype, MBG, photograph and analytical drawings).

12. **KIBATALIA BLANCOI** (Rolfe) Merr.

Kibatalia Blancoi (Rolfe) MERR., Philip. Journ. Sci. 17 (1920) 309.
Kickxia arborea F.-VILL., Nov. Append. (1880) 132; NAVES, in Blanco, Fl. Filip. ed. 3 (1877–83) *pl. 428 bis* non Blume.
Kickxia Blancoi ROLFE, Journ. Linn. Soc. Bot. 21 (1884) 313.

Trees; stems relatively stout, glabrous, rather obscurely lenticellate when fully mature; leaves oblong-elliptic, apex obtuse to very shortly and obtusely acuminate, base obtuse, 3 to 13 cm long, 1 to 4 cm broad, subcoriaceous, glabrous, or occasionally indefinitely puberulent-papillate beneath; petioles 0.2 to 0.5 cm long; inflorescence 1- to 4-flowered; peduncle scarcely manifest, glabrous; pedicels 1.3 to 1.7 cm long, glabrous; calyx lobes broadly ovate to ovate-subreniform, obtuse to rounded, 0.35 to 0.45 cm long, papillate without, the squamellæ alternate with the calyx lobes, lacerate and irregularly divided; corolla infundibuliform, white (according to Naves), the proper tube 0.6 to 0.8 cm long, about 0.4 cm in diameter at the base, abruptly constricted at the insertion of the stamens, glabrous within and

without, the throat cylindric-campanulate, 0.5 to 0.65 cm long, about 0.5 to 0.6 cm in diameter at the orifice, essentially glabrous without, minutely puberulent within, the lobes obliquely elliptic, acute to obtuse, 4 to 4.5 cm long, 1.2 to 1.4 cm broad, indefinitely papillate within and without; anthers included within the corolla throat, 0.6 to 0.7 cm long, minutely pilosulose towards the tip dorsally, the gland compressed-ovoid, relatively inconspicuous; ovary oblongoid, about 0.2 cm long, minutely puberulent; nectaries concrescent, obscurely lobed, nearly equaling the ovary; follicles unknown.

Philippine Islands. GUIMARAS, *F. B. 862 Gammill,* June, 1904 (BSM, NY, US, MBG, photograph). Data incomplete, *Loher 6329* (BSM, NY).

Also said to occur in Panay and Negros. The identity of this species rests essentially upon the plate in the third edition of Blanco's Flora de Filipinas, supplemented by Villar's short notes in the Novissima Appendix (1880) 132. The plate is an excellent one, corresponding exactly with the specimens from Guimaras Island collected by Gammill. Villar noted, as well, that specimens of the species represented by the plate referred to had been collected on Guimaras and at Igbaras, Iloilo Province, Panay. The identification of the plants cited above therefore appears secure.

Merrill's [9] interpretation of *K. Blancoi* is much broader than that adopted here, including *K. Merrittii, K. Macgregorii, K. Elmeri,* and *K. Merrilliana,* which are maintained as valid in this account of *Kibatalia.* My reasons for a more restricted interpretation are sufficiently outlined in the key to species immediately preceding. *Kibatalia Merrilliana* is particularly outstanding in the peculiar form of the nectary. Naturally field knowledge of the plants, impossible for me at present, is necessary for a surer interpretation of such closely related entities. Although authentic exsiccatæ of the four segregates of the inclusive *K. Blancoi* enumerated above were cited by Merrill,[10] it appears significant in the light of his interpretations that the specimens collected by Gammill and by Loher were not. The latter are the only specimens I have seen that exactly correspond to Naves's plate.

[9] Philip. Journ. Sci. 17 (1920) 309. [10] Loc. cit.

13. KIBATALIA PUBERULA Merr.

Kibatalia puberula MERR., Philip. Journ. Sci. 30 (1926) 423.

Small trees (according to Merrill); stems relatively stout, very minutely puberulent when young, soon becoming glabrate, inconspicuously lenticellate when fully mature; leaves broadly elliptic, apex very shortly and obtusely subcaudate-acuminate, base very broadly obtuse to rounded, 12 to 16 cm long, 5 to 9 cm broad, rather delicately membranaceous (subcoriaceous according to Merrill), glabrous above, very minutely and indefinitely puberulent beneath; petioles 0.3 to 0.4 cm long; inflorescence 1- to 3-flowered; peduncle about equaling the subtending petioles, essentially glabrous; pedicels about 2.5 cm long, very minutely and indefinitely puberulent; calyx lobes ovate-subreniform, obtuse, puberulent-papillate without, 0.3 to 0.4 cm long, the squamellæ alternate, solitary, minutely erose; corolla infundibuliform, white (according to Merrill), the proper tube 0.6 to 0.7 cm long, about 0.35 cm in diameter at the base, minutely papillate without, puberulent-papillate within, the throat cylindric, 0.8 to 1 cm long, about 0.45 cm in diameter at the orifice, minutely papillate without, puberulent within, the lobes oblanceolate-elliptic, broadly obtuse to rounded, 6 to 6.5 cm long, 0.8 to 1.2 cm broad, spreading, papillate within and without; anthers included within the corolla throat, or the tips barely exserted, 0.65 to 0.7 cm long, minutely and sparsely barbellate, the gland compressed, ovoid-subreniform, relatively conspicuous; ovary ovoid, about 0.15 cm long, essentially glabrous; nectaries concrescent, deeply 5-lobed, the margins ciliate, about half equaling the ovary; follicles unknown.

Philippine Islands. SAMAR, Loquilocon, overhanging streams, altitude 250 meters, *Bur. Sci. 43767 McGregor*, July, 1924 (NY, isotype, MBG, photograph and analytical drawings).

14. KIBATALIA ELMERI Woodson sp. nov.

Kibatalia Blancoi (Rolfe) MERR., Philip. Journ. Sci. 17 (1920) 309, as to specimens cited, in part.

Arborea ut dicitur 5–15 m attingens; ramulis crassiusculis glaberrimis maturitate sat inconspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice plerisque obtuse breviterque acuminatis basi obtuse acuteve cuneatis 4–12 cm longis, 1.5–3 cm latis coriaceis vel subcoriaceis omnino glaberrimis; petiolis 0.4–0.8 cm longis; inflorescentiis 1–3-floris; pe-

dunculo petiolos subbrevioribus; pedicellis 0.7–1 cm longis, glabriusculis; calycis laciniis late ovatis vel ovato-subreniformibus obtusis vel rotundatis, 0.35–0.5 cm longis extus papillatis squamellis alternatis solitariis rariusve geminis; corollae infundibuliformis ut dicitur albidae tubo proprio cylindrico-ampuliforme 1.5–1.8 cm longis basi 0.4–0.45 cm diametro metiente usque ad insertionem staminis gradatim angustato ibique ca. 0.2–0.25 cm diametro metiente extus glabro intus minute puberulo faucibus conico-campanulatis 0.7–0.8 cm longis ostio ca. 0.7–0.8 cm diametro metiente extus glabriusculis intus puberulis lobis oblique obovatis obtusis rotundatisve 4.5–5 cm longis 2–2.5 cm latis patulis intus extusque minute papillatis; antheris 0.6–0.65 cm longis in corollae faucibus inclusis dorso puberulis glandulo ovoideo valde manifesto; ovario oblongoideo ca. 0.2 cm longo glabriusculo; nectariis concrescentibus subintegris ovario subaequantibus; folliculis crassiusculis rigidis obtusis 12–17 cm longis ca. 1–1.5 cm diametro metientibus glabris divaricatis; seminibus ignotis.

Philippine Islands. LUZON, Irosin, Mount Bulusan, *Elmer 15934*, May, 1916 (BSM, MBG, type, NY, US), *Elmer 15270*, November, 1915 (BSM, MBG, cotype, NY, US): Laguna Province, Mount Maquiling, *F. B. 25726 Mabesa*, May, 1916 (BSM, US): Batangas Province, hillside near cogonal, *F. B. 21545 Tamesis*, May 18, 1910 (BSM): Ilocos Sur Province, hillside, *F. B. 25863 Adduru*, May 4, 1916 (BSM): Zambales Province, *Warburg 13775*, 1888 (BSM). MINDORO, Paluan, in deep forest, *Bur. Sci. 39812 Ramos*, March 29, 1921 (BSM, US). CATANDUANES, Colobon, Mount Taganasan, on top of ridge, *F. B. 28110 Mabbayag*, August 22, 1920 (BSM).

Popular names of this species are said to be "lancteng-gubat" (Tag.) and "cagpaayan" (Il.).

15. KIBATALIA MACGREGORII (Elm.) Woodson comb. nov.

Kickxia Macgregorii ELM., Leafl. Philip. Bot. 4 (1912) 1457.

Trees 8 to 10 m tall (according to collectors); stems relatively stout, glabrous, rather conspicuously (for the genus) lenticellate when fully mature; leaves oblong-elliptic, apex acutely to obtusely acuminate, base acutely to obtusely cuneate, 8 to 12 cm long, 1 to 3 cm broad, firmly membranaceous to subcoriaceous, glabrous throughout; petioles 0.3 to 0.7 cm long; inflorescence 1- or 2-flowered; peduncle scarcely manifest, glabrous; pedicels 1 to 1.5 cm long, glabrous; calyx lobes ovate, acute to obtuse, 0.3 to 0.35 cm long, minutely papillate without, the squamellæ

solitary, alternate with the calyx lobes; corolla infundibuliform, greenish white (according to Elmer), the proper tube cylindric, but little inflated at the base, 1.4 to 1.6 cm long, about 0.25 cm in diameter at the base, essentially glabrous without, minutely puberulent within, the throat subcylindric, 0.7 to 0.75 cm long, about 0.4 to 0.5 cm in diameter at the orifice, minutely papillate without, puberulent within, the lobes obliquely elliptic, acute, 3 to 3.2 cm long, 0.6 to 0.7 cm broad, very minutely and indefinitely papillate within and without, patulous; anthers essentially included within the corolla throat, 0.4 to 0.45 cm long, minutely barbellate; ovary ovoid-oblongoid, about 0.15 cm long, minutely and rather sparsely puberulent; nectaries concrescent, 5-lobed, about equaling the ovary; follicles unknown.

Philippine Islands. LUZON, Ilocos Sur Province, *F. B. 25465 Paraiso,* March 20, 1916 (BSM). SIBUYAN, Magallanes, Mount Giting-Giting, on the España side of the trail, near streamlets at 1,750 feet, *Elmer 12373,* April 1910 (MBG, NY, US, isotypes).

Possibly conspecific with *K. Elmeri.* With as many closely related entities occupying contiguous territory as the kibatalias in the Philippine Islands, one would suspect the possibility of hybridization, the bane of taxonomists. An indication of such a contingency may be the report by several collectors that the plants "are never known to fruit."

16. KIBATALIA MERRILLIANA Woodson sp. nov.

Arborea ut dicitur usque ad 10 m altitudine attingens; ramulis sat crassiusculis glaberrimis maturitate sat conspicue lenticellatis; foliis oppositis breviter petiolatis oblongo-ellipticis apice obtuse breviterque subcaudato-acuminatis basi obtuse cuneatis 7.5–14 cm longis, 2.5–4.5 cm latis, firme membranaceis subcoriaceisve omnino glaberrimis vel subtus indistinctissime papillatis; petiolis 0.4–0.5 cm longis; inflorescentiis 1–2-floris; pedunculo petiolis subbreviore glabro; pedicellis 2–2.5 cm longis glabris; calycis laciniis ovato-subreniformibus rotundatis 0.35–0.4 cm longis extus minute papillatis squamellis alternatis solitariis; corollae infundibuliformis ut dicitur albidae tubo proprio cylindrico-ampulliforme 2.5–2.7 cm longo basi ca. 0.8 cm diametro metiente deinde prope ostium gradatim angustato ostio ca. 0.35 cm diametro metiente extus glabriusculo intus minute puberulo faucibus campanulatis 0.7–0.8 cm longis ca. 0.7–0.8 cm diametro metientibus extus indistincte papillatis intus minute puberulis lobis oblique obovatis rotundatis 3.4–3.5 cm longis minute papillatis; antheris in faucibus corollae inclusis 0.6 cm longis gla-

briusculis; ovario oblongoideo ca. 0.3 cm longo minute sparseque pilosulo; nectariis concrescentibus funiformibus apice obscure 5-lobatis 0.5–0.55 cm longis delicate membranaceis minute puberulo-papillatis; folliculis ignotis.

Philippine Islands. LEYTE, Dagami, forest, altitude 60 meters, *Wenzel 330*, July 22, 1913 (BSM, US, type, MBG, photograph and analytical drawings).

This may be the specimen cited as *Wenzel 320* by Merrill[11] under the inclusive species *K. Blancoi.* In general habit it is somewhat similar to *K. Elmeri,* but upon dissection the flower is found to differ in the surprising development of the nectary.

17. KIBATALIA WIGMANI (Koord.) Merr.

Kibatalia Wigmani (Koord.) MERR., Philip. Journ. Sci. 17 (1920) 310 (where erroneously cited as *K. Wigmani* Koord.).
Kickxia Wigmani KOORD., Meded. s'Lands Plantent. 19 (1898) 528.

Trees 12 to 15 m tall; stems relatively slender, glabrous; leaves lanceolate to oblong-lanceolate, rarely oblong, apex shortly and acutely acuminate, base acutely cuneate, about 24 cm long and 6 cm broad, coriaceous, glabrous; petioles about 0.5 cm long; inflorescence 2-flowered; pedicels about 1.5 cm long; calyx lobes ovate, acute, about 1 cm long, essentially glabrous, the squamellæ numerous, indefinitely distributed, almost forming an erose ring; corolla infundibuliform, evidently white, the tube (sensu latiore) about 3.2 cm long, 1 to 1.1 cm in diameter at the orifice, glabrous without, villous within, the lobes oblong, about 7 cm long and 2.2 cm broad, spreading; anthers included, minutely puberulent dorsally; nectaries concrescent, obscurely 5-lobed, about equaling the ovary; follicles 28 to 29 cm long; seeds 3 to 3.4 cm long, the rostrum about 6 cm long, the coma about 6 cm long.

The description of this species from northeastern Celebes has had to be adapted from the original diagnosis by Koorders, as I have not been able to examine authentic specimens.

18. KIBATALIA ARBOREA (Blume) G. Don.

Kibatalia arborea (Blume) G. DON, Gen. Syst. 2 (1838) 86.
Hasseltia arborea BLUME, Bijdr. (1826) 1045.
Kixia arborea BLUME, Fl. Jav. Praef. 1 (1828) 7; A. DC. in DC., Prodr. 8 (1844) 408.
Kickxia arborea BLUME, Rumphia 4 (1848) 26, *pl. 179, fig. 1.*

[11] Philip. Journ. Sci. 17 (1920) 309.

Trees; stems relatively stout, glabrous, rather inconspicuously lenticellate when fully mature; leaves broadly ovate- to oblong-elliptic, apex broadly obtuse to very shortly and obtusely acuminate, base broadly obtuse to rounded, 11 to 25 cm long, 4.5 to 12 cm broad, membranaceous, glabrous above, very minutely and generally puberulent beneath; petioles 0.5 to 0.8 cm long; inflorescence 1- to 5-flowered; peduncle somewhat shorter than the subtending petioles; pedicels 3.5 to 4 cm long, glabrous; calyx lobes ovate to ovate-lanceolate, acute to acuminate, 0.5 to 0.6 cm long, minutely papillate to puberulent-papillate without, the squamellæ numerous, indefinitely distributed; corolla infundibuliform, evidently white, the proper tube narrowly flask-form, 1.2 to 1.8 cm long, about 0.35 cm in diameter at the base, gradually narrowing to 0.2 cm at the insertion of the stamens, minutely papillate to essentially glabrous without, minutely puberulent within, the throat campanulate to conical-campanulate, 1 to 1.3 cm long, 0.7 to 0.8 cm in diameter at the orifice, minutely papillate without, puberulent within, the lobes obliquely obovate, broadly obtuse to rounded, 3.5 to 3.8 cm long, minutely papillate, spreading; anthers essentially included within the corolla throat, 0.6 to 0.7 cm long, essentially glabrous dorsally; ovary ovoid-oblongoid, about 0.2 cm long, essentially glabrous; nectaries concrescent, 5-lobed, nearly equaling the ovary; follicles unknown.

JAVA, cultivated at Buitenzorg, date lacking, *Merrill s. n.* (NY, US); data incomplete, *Sargent s. n.* (MBG); *Kollmann s. n.* (NY).

EXCLUDED SPECIES

KIBATALIA AFRICANA (Benth.) Merr., Philip. Journ. Sci. 17 (1920) 309.
Kickxia africana BENTH. in Hook., Ic. III 3 (1877–79) 59, *pl. 1276* = **Funtumia africana** (Benth.) STAPF in Hook., Ic. 27 (1901) *pls. 2696–2697.*

KIBATALIA ELASTICA (Preuss) Merr., Philip. Journ. Sci. 17 (1920) 309.
Kickxia elastica PREUSS, Notizblatt 2 (1899) 353 = **Funtumia elastica** (Preuss) STAPF in Hook., Ic. Pl. 27 (1901) *pls. 2694–2695.*

KIBATALIA LATIFOLIA (Stapf) Merr., Philip. Journ. Sci. 17 (1920) 309.
Kickxia latifolia STAPF, Kew Bull. (1898) 307 = **Funtumia latifolia** STAPF, in Hook., Ic. Pl. 27 (1901) *pls. 2694–2695.*

KIBATALIA SCHEFFERI (K. Sch.) Merr., Philip. Journ. Sci. 17 (1920) 309.
Kickxia Schefferi K. SCH., Notizblatt 3 (1900) 81. Very similar to *F. africana,* according to Stapf, loc. cit.

KIBATALIA ZENKERI (K. Sch.) Merr., Philip. Journ. Sci. 17 (1920) 310.
Kickxia Zenkeri K. SCH., Notizblatt 3 (1900) 81. Approaches *F. latifolia* very closely, according to Stapf, loc. cit.

THE IDENTITY AND AFFINITIES OF VALLARIS LANCIFOLIA HOOK. F.

Vallaris lancifolia Hook. f.[12] appears to be conspecific with neither *V. Pergulana* Burm., the type species of the genus, nor *V. Maingayi* Hook. f. with which it was originally associated by the younger Hooker. Of the two it most nearly resembles the latter in its erect habit, few-flowered lateral cymes, and anthers without the conspicuous dorsal gland characteristic of true *Vallaris*. Discrepancies with *V. Maingayi* [=*Kibatalia Maingayi* (Hook. f.) Woodson], however, are outstanding. The cymes of *V. lancifolia* are in opposite foliar axils, whereas those of all known species of *Kibatalia*, as well as of *Funtumia*, *Malouetia*, and *Forsteronia*, are alternate-axillary. The leaves of *V. lancifolia*, also, are not foveate in the axils of the midrib beneath. Two of the most generalized features of the foveate-leaved alliance of both Old and New World Echitoideæ are thus absent in *V. lancifolia*, with which it can scarcely be identified by several features of construction of the reproductive structures as well. The dorsal boss of the anthers of *V. lancifolia* is scarcely to be associated with the conspicuous staminal glands of *Vallaris* and *Kibatalia*, as believed by Hooker, since the former is apparently only a median contour of the connective proper, whereas the latter are definitely glandular hypertrophies of the filament.

Since *V. lancifolia* can scarcely be included within the neighboring genus *Pottsia* because of the salverform corolla, completely exserted stamens, fusiform style, and compound dichasial inflorescence of the latter, the most logical interpretation would apparently involve the establishment of a distinct genus:

Genus VALLARIOPSIS Woodson gen. nov. Apocynacearum (Echitoideæ)

Calyx profunde 5-partitus; laciniae scariaceae aequales margine imbricatae intus basi squamellas minutas plus minusve numerosas uniforme gerentes. Corolla speciei nostri subinfundibuliformis sat parva; tubus inferne cylindricus dein in fauces campanulatas viz bene manifestas dilatatus; limbi laciniae 5 aequales aestivatione dextrorsum convolutae. Stamina 5; antherae inter se adglutinatae et stigmati adplicatae anguste sagittatae dorso umbonem linearem gerentes basi angustissime 2-auriculatae dimidia parte superiore ventro pollinigerae apice exsertae, pollinibus granulosis; filamenta ligulata haud glandu-

[12] Fl. Brit. Ind. 3 (1882) 651.

ligera. Ovarii carpella gemina basi distincta apice in stylo filiforme producta, ovulis multis pluriseriatim superpositis; stigma capitato-fusiforme apice obscure 2-partitum. Nectarii glandulae 5 separatae vel basi paululo connatae. Folliculae ignotae. Frutices lactescentes epiphytici; folia opposita petiolata eglandulosa efoveolataque. Inflorescentia lateralis opposita subumbellata.

VALLARIOPSIS LANCIFOLIA (Hook. f.) Woodson comb. nov.

Vallaris lancifolia HOOK. F., Fl. Brit. Ind. 3 (1882) 651; KING and GAMBLE, Mat. Fl. Malay Pen. 4^2 (1907) 671.

Said to be an epiphytic shrub. The only specimen seen by me is the type (*Maingay 1048* in Hb. Kew; photograph and analytical drawings in Hb. Missouri Bot. Garden) from Malacca. Also reported from Penang and Perak by King and Gamble (loc. cit.).

ILLUSTRATION

PLATE 1

The foliar foveæ of certain genera of Echitoideæ; figs. 1 to 5, $\times$ 10; fig. 6, $\times$ 215.

FIG. 1. *Funtumia elastica* (Preuss) Stapf.
2. *Malouetia Schomburgki* Muell.-Arg.
3. *Forsteronia glabrescens* Muell.-Arg.
4. *Kibatalia Macgregorii* (Elmer) Woodson.
5. *Kibatalia microphylla* (Pitard) Woodson.
6. *Funtumia elastica* (Preuss) Stapf, transverse section.

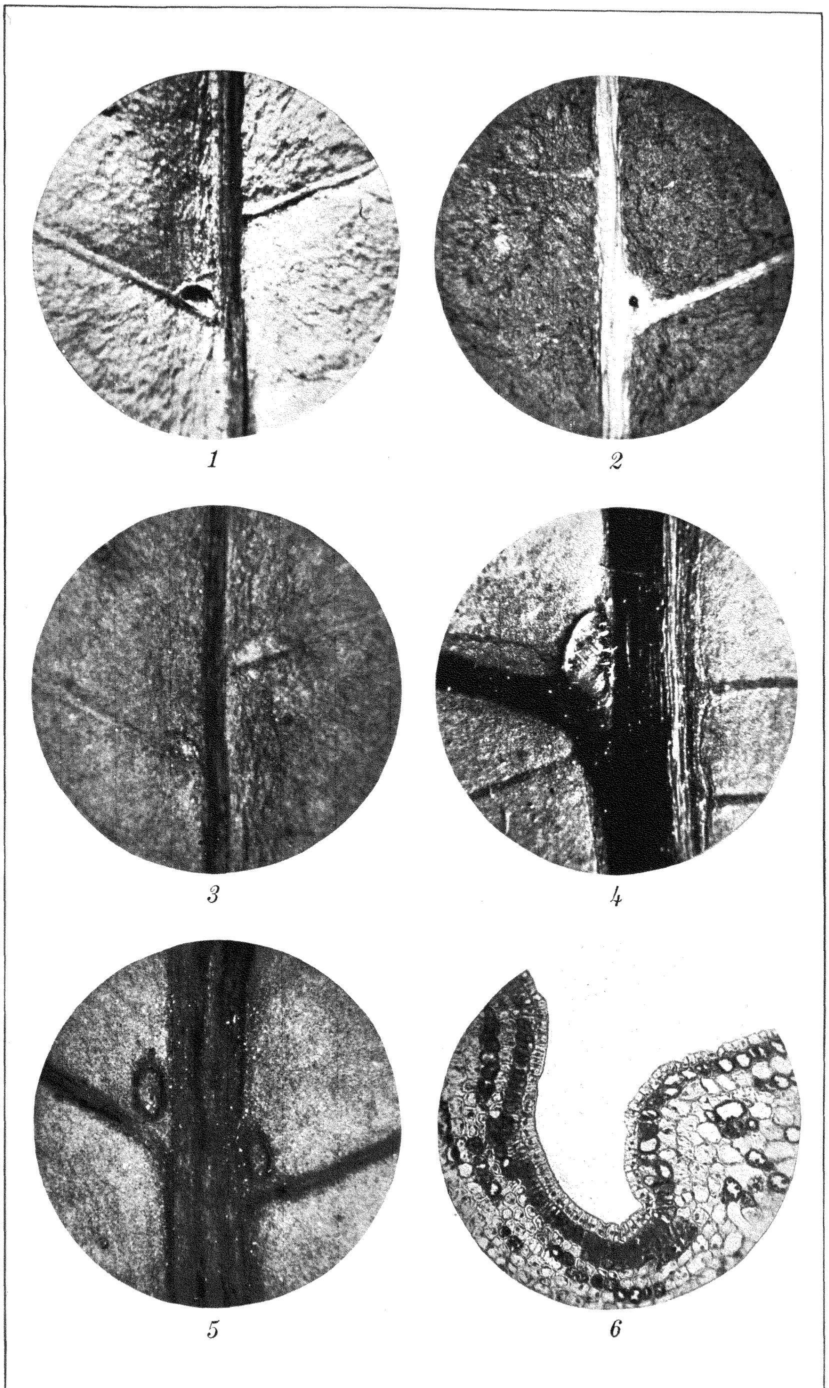

PLATE 1.

A NEW PHILIPPINE SPECIES OF CYCAS

By E. D. MERRILL

Of the Gray Herbarium, Harvard University, Cambridge, Massachusetts

FOUR PLATES

February 11, 1902, I made a single day's trip inland from Halsey Harbor, Culion, the objective being a large open grassy area locally known as the *cogonal grande* or the *patag grande* originally selected as a possible site for the Culion leper colony. Towards the northern part of this area my attention was called to a number of characteristic *Cycas* plants, these mostly 1 to 2 m high, growing on open gentle slopes in the cogon (*Imperata*) area. A number of these were examined, but none of the plants bore traces of either male cones or female sporophylls. I accordingly had to content myself with collecting a few leaves. Until 1923 this single collection represented all that was known regarding this cycad.

In the early part of 1908 I compared the Kew specimen of my No. 657 with the *Cycas* material in that herbarium, concluding that the only close match was the Australian *Cycas cairnsiana* F. Muell. In my Enumeration [1] I placed this number under F. Mueller's species with the comment: "A curious species, of which only the leaves are known, perhaps representing the above Australian species."

Although several attempts were made by correspondents and friends to locate this *Cycas* in Culion it was not until April, 1923, that additional material came in when Dr. G. A. Perkins and Dr. H. W. Wade found the species near where I had originally collected it, and sent portions of a single leaf and a few male sporophylls to Manila. Previous trips made by Doctors Perkins and Wade had failed in their objectives, probably for the reason that my trip was made eastward from Halsey Harbor on the west coast of the island, and their trips were made westward from the Culion Leper Colony on the east coast. On the trip in April, 1923, which resulted in the relocation of the species, the plants were found late in the afternoon after Doctors Wade and Perkins had been on the trail for about seven hours. Later

[1] Enum. Philip. Fl. Pl. 1 (1922) 1.

abundant material with staminate cones, female sporophylls, and mature fruits was collected by Dr. W. H. Brown. At the same time Doctor Wade transplanted some of the mature cycads to the Culion Leper Colony, two of which were taken to Manila and established on the Bureau of Science grounds. In April, 1931, leaves with female sporophylls and fruits were collected by Dr. A. W. Herre in Culion. It was the receipt of this last collection for identification that reminded me of the unsolved problems associated with this interesting cycad, which lead me to communicate with Dr. W. H. Brown, asking for the loan of the available material that would enable me to prepare a reasonably complete description. In the meantime, however, J. Schuster [2] had attached a cumbersome quadrinomial to this Culion species on the basis of the original sterile collection, calling it *Cycas circinnalis* Linn. subsp. *riuminiana* (Porte) var. *curranii* Schuster, forma *graminea* Schuster. Complete material clearly shows that Doctor Schuster was as far from the true alliances of this Culion cycad in sinking it in *Cycas circinnalis* Linn., which he treats as a collective species, as I was in referring it to *C. cairnsiana* F. Muell.; both of these belong in the section *Lemuricæ,* while the Culion plant actually belongs in the section *Indosinenses,* in the alliance with *Cycas inermis* Lour. With his apparently broad concept of specific limits Doctor Schuster doubtless would have made this a form, variety, or subspecies of *Cycas siamensis* Miq. under which he placed *C. inermis* Lour. as a subspecies. After a careful consideration of all factors I prefer to consider the Culion plant as worthy of specific rank and accordingly supply the following technical description. In describing this as *Cycas Wadei* I would explain that the specific name is selected to commemorate the services of Dr. H. Windsor Wade, for many years in charge of research at the Culion Leper Colony, to whom we are indebted for much of our information regarding the plant, as well as for photographs, mature fruits and other botanical material, and maximum and minimum measurements of various plants as they occur in nature.

CYCAS WADEI sp. nov. § Indo-sinenses.

Cycas circinnalis Linn. subsp. *riuminiana* Schuster var. *curranii* Schuster forma *graminea* SCHUSTER in Pflanzenreich **99** (IV–1) (1932) 69.

Cycas sp. FOXW. in Philip. Journ. Sci. **6** (1911) Bot. 151.

Cycas cairnsiana MERR., Enum. Philip. Fl. Pl. **1** (1922) 1, non F. Muell.

[2] Cycadeae, Pflanzenreich **99** (IV–1) (1932) 69.

Truncis usque ad 5.3 m altis, plerumque multo brevioris, basi incrassatis, 30–40 cm diametro, sursum reductis, infra foliis 10–20 cm diametro; foliis numerosis, circiter 25 cm longis, petiolo breviter spinoso, foliolis utrinque circiter 90, confertis, crassis, rigidis, acute acuminatis, lineari-lanceolatis, rectis vel leviter falcatis, planis, 4–5 mm latis, medianis 15–20 cm longis, inferioribus brevioribus, infimis 8 cm longis; strobilis ♂ cylindraceis, 40–55 cm diametro, sursum angustatis, microsporophyllis numerosissimis, confertis, sphenoideis, medianis circiter 3 cm longis, deorsum valde angustatis, sursum triangularis, basi acutis, apice truncatis, 1.5–2 cm latis, in acuminis tenuibus fragilibus sursum arrectis 5–6 mm longis productis, obscure 5-dentatis vel breviter 5-lobatis; megasporophyllis ferrugineo-tomentosis, usque ad 22 cm longis, pedunculis circiter 15 cm longis et 1 cm latis, megasporangiis 1–3 gerentibus, laminis terminalibus sterilis in ambitu ovatis, circiter 10 cm longis, 7 cm latis, ferrugineo-pubescentibus, longe acuminatis, pectinato-pinnatifidis, lobis utrinque circiter 15, linearis, acute acuminatis, sursum glabris, usque ad 3.5 cm longis; fructibus ellipsoideis vel ovoideis, rotundatis, 3.2–4 cm longis, 2.5–3 cm diametro, putamine longitudinaliter distincte 9-15-costatum.

Trunk [3] up to 5.3 m high, usually much shorter, and in many mature plants less than 1 m high, often branched, base swollen, usually tapering above, varying in diameter from 30 to 48 cm at the base and from 10 to 20 cm below the crown of leaves, the swollen base tapering rather abruptly in the lower 20 to 45 cm, and much more gradually above. Leaves numerous in the terminal crown, crowded, about 75 cm long, 25 to 30 cm wide, the petiolar part about 20 cm long and with two rows of short spines in positions corresponding to the attachment of the leaflets, but with no transition from leaflets to spines, these spines acute, about 1.5 mm long, spaced on the average about 6 mm apart, the petiole 5 to 10 mm in diameter, the rachis rounded and smooth on the lower surface, the upper surface blunt-angled, the sloping sides and basal parts of the leaflets on the upper surface in young leaves cinnamomeous-pilose, in age entirely

[3] A striking character of the trunk is the presence of pronounced rings around it, which are plainly shown in a number of the illustrations. A male plant growing in the grounds of the Bureau of Science branched and rebranched until it had a number of heads, and each head produced a cone. Gradually most of the heads died out and eventually there were four left as is shown in the illustration. There was nothing to indicate that this branching was due to injury or any other abnormal circumstance.

glabrous. Leaflets rather close, about 90 on each side of the rachis, linear to linear-lanceolate, coriaceous, rigid, straight or somewhat falcate, spaced at about the rate of 9 on each side within a distance of 5 cm, flat, not at all revolute, smooth, sharply acuminate, base slightly narrowed, 4 to 5 mm wide, the median ones 15 to 20 cm long, the lowest ones but 8 cm long, but with no transition into petiolar spines, the uppermost ones again shorter, about 8 cm long; male cones cylindric, somewhat narrowed below, more strongly tapering upward, 40 to 70 cm long, 9 to 10 cm in diameter, the microsporophylls very numerous, crowded, the median ones about 3 cm long, the claw rather narrow, the somewhat rhomboid limb 1.5 to 2 cm wide, tapering below, the apex truncate, the lower surface of both claw and limb covered with microsporangia, the upper surface of the limb glabrous, the exposed sterile end puberulent, about 2 cm wide and 1 cm high, ascending at about a right angle, the tip thin, ovate from the broad base, 5 to 6 mm long and wide, rounded to acute or to somewhat acuminate, not conspicuous, with usually 3 to 5 slender teeth or short narrow lobes, sometimes nearly entire. Megasporophylls up to 22 cm long, rather densely ferruginous-pilose, the peduncular part about 15 cm long, 1 cm wide, bearing few, usually but two, megasporangia, the sterile limb ovate in outline, up to 10 cm long and 8 cm wide, pectinate-pinnatifid, the lobes about 15 on each side, usually ascending, linear, rather rigid, sharp-pointed, pubescent below, glabrous above, or entirely glabrous, up to 3.5 cm long, the tips of the sterile limbs usually long-acuminate, with few, gradually shorter, ascending lobes or the uppermost ones often reduced to teeth only 1 to 2 mm long. Fruits ovoid to ellipsoid, sessile, not at all compressed, brown, glabrous, shining, somewhat rugose when dry, apex rounded, rarely obscurely and minutely apiculate, 3.2 to 4 cm long, 2.5 to 3 cm in diameter. Seeds conforming to the fruit in shape, the putamen woody, pale, somewhat shining, longitudinally 9- to 15-ribbed.

CULION, Cogonal Grande or Patag Grande, *Merrill 657*, February 11, 1902, a sterile specimen, type of forma *graminea* Schuster of *Cycas circinnalis* Linn. subsp. *riuminiana* Schuster var. *curranii* Schuster; *H. W. Wade and G. A. Perkins*, April 4, 1923, with staminate sporophylls; *A. W. Herre 1061*, April 27, 1931; and abundant material secured by W. H. Brown, the type collection.

Mature plants of this interesting *Cycas* are now in cultivation at the Culion Leper Colony and in the grounds of the Bureau of Science, Manila, while seedlings are in cultivation at the New York Botanical Garden and the Coconut Grove Palmetum in Florida; viable seeds were transmitted to the Royal Botanic Gardens at Kew and to the Botanical Garden at Berlin.

Striking characters of the present species are found in its unusually narrow leaflets and in its distinctly ribbed putamen. In *Cycas circinnalis* and its allied species the putamen is very smooth; it is perhaps ribbed in some of the *Indosinenses* species, but I have no data on this point.

302523——3

ILLUSTRATIONS

PLATE 1. CYCAS WADEI MERRILL

FIG. 1. Male plant grown naturally in Culion, with two cones indicating two heads.

2. Branched specimen growing naturally in Culion.

PLATE 2. CYCAS WADEI MERRILL

FIG. 1. Male plant grown in the Bureau of Science grounds. The main trunk has four heads.

2. Female plant grown in the Bureau of Science grounds, Manila.

PLATE 3. CYCAS WADEI MERRILL

FIG. 1. Male cones.

2. The young "cone" of megasporophylls.

3. Crown of a female plant showing megasporophylls and juvenile leaves.

4. Crown showing leaf bases and megasporophylls.

PLATE 4. CYCAS WADEI MERRILL

FIG. 1. Male cone.

2. Longitudinal section of a male cone.

3. Megasporophyll with an ovule.

4. Ovules.

5. Seeds showing ribbed putamen.

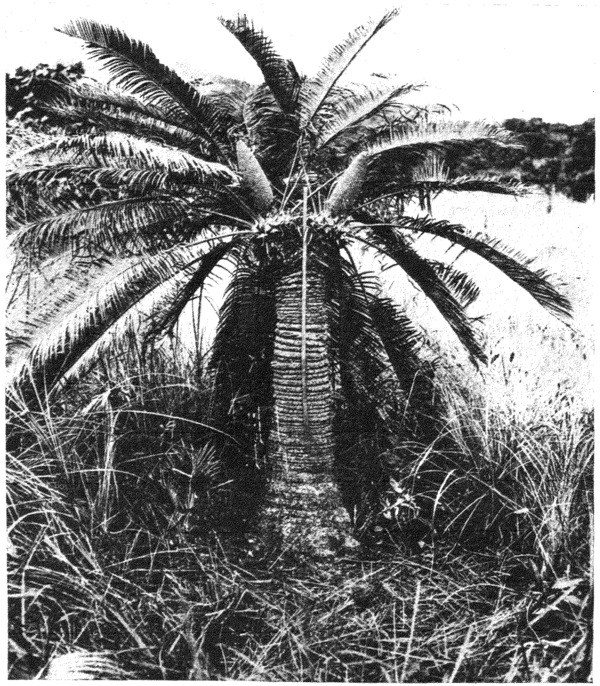

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PLATE 1.

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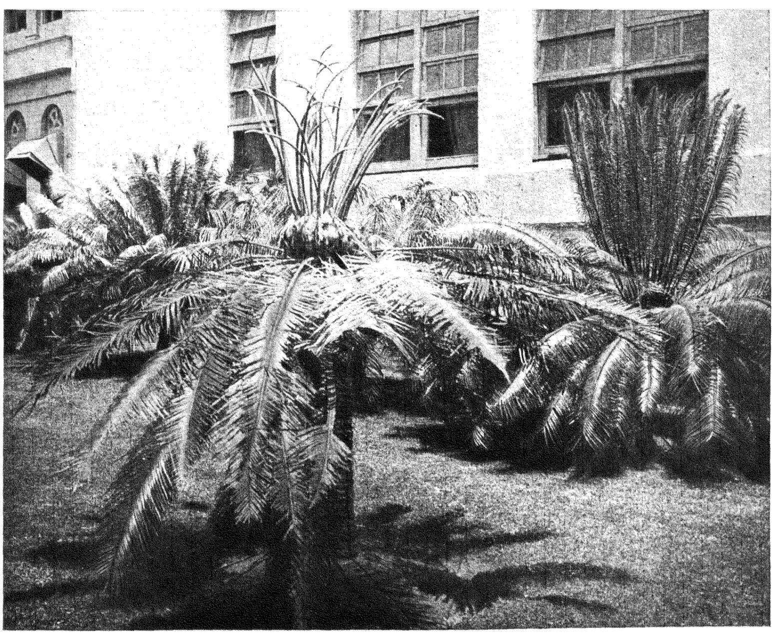

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PLATE 2.

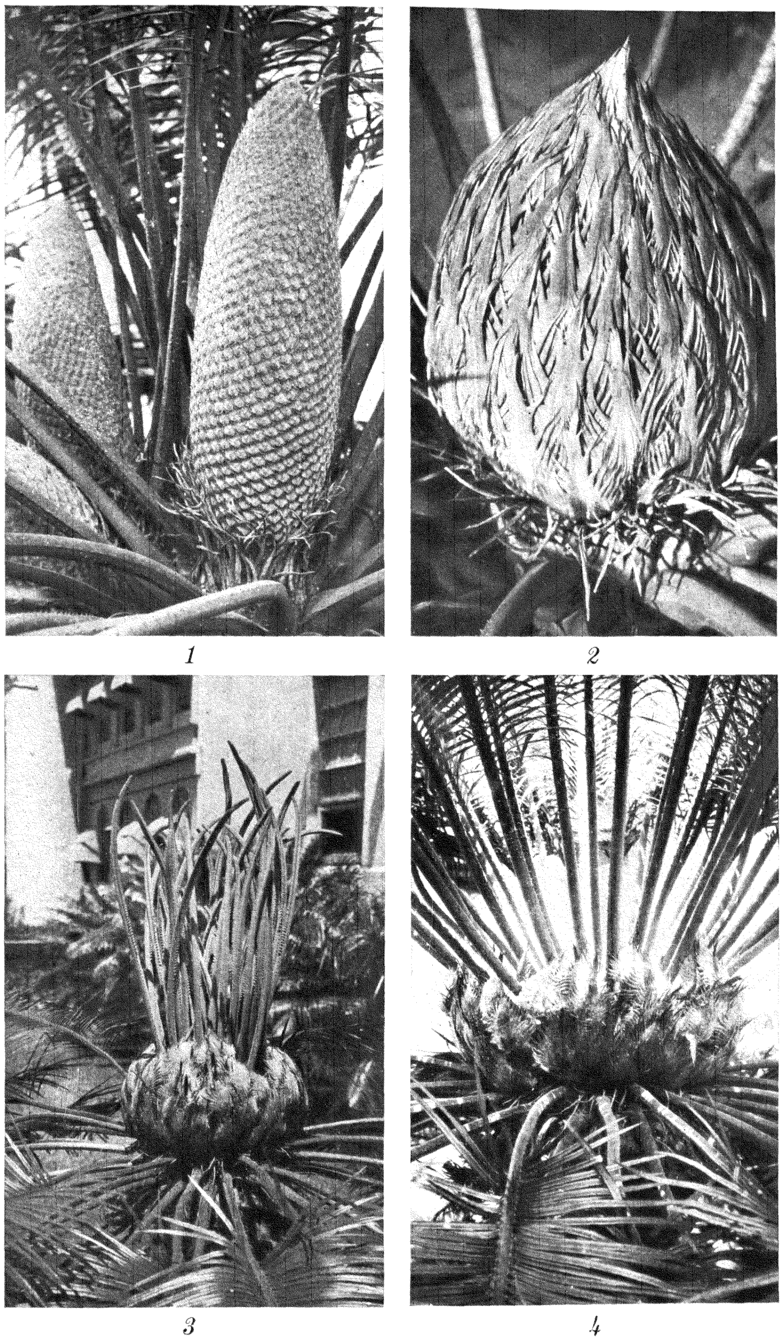


PLATE 3.

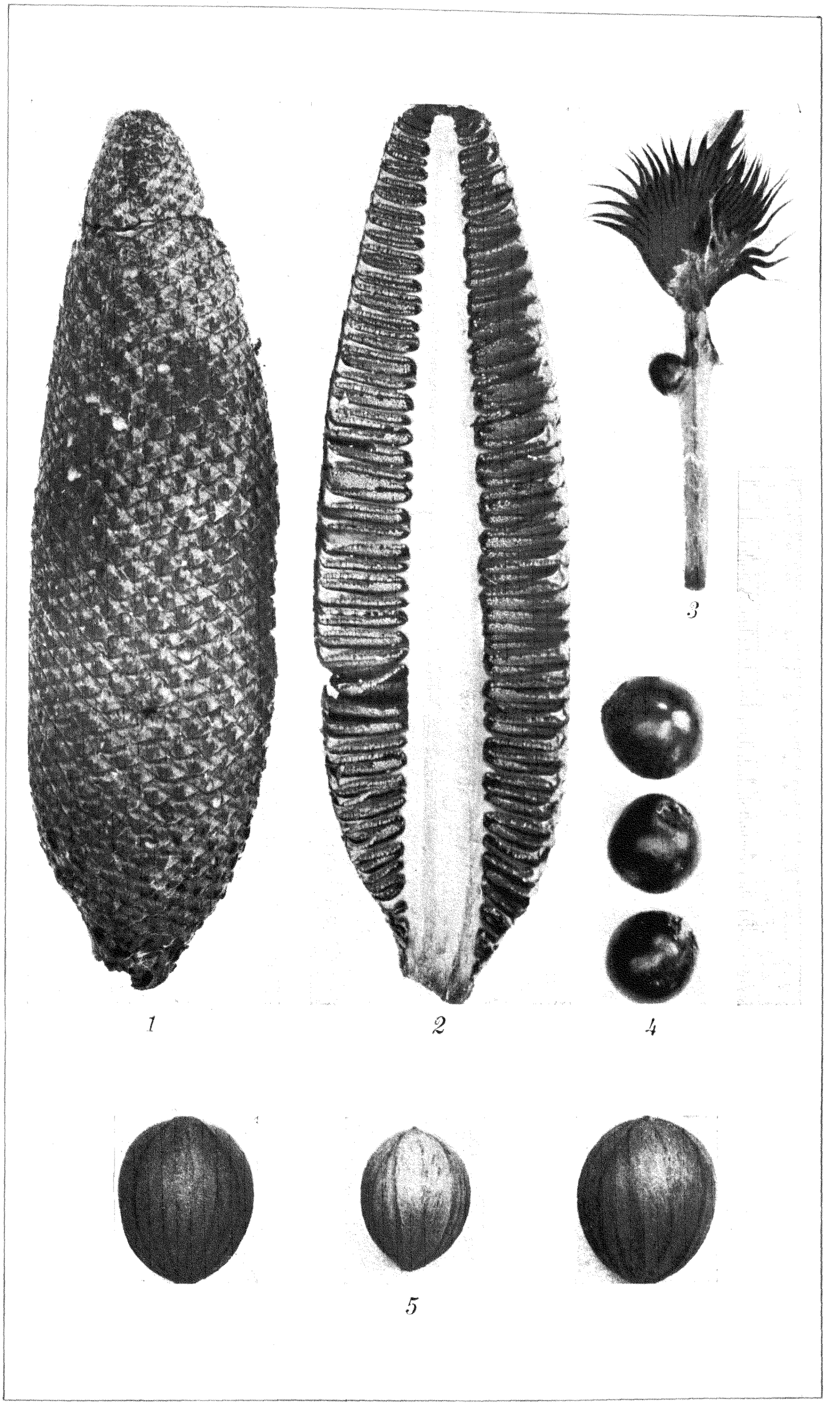


PLATE 4.

EFFECT OF MOLDS ON BAKAUAN BARK AND TANNING LIQUORS

By F. M. YENKO, LUZ BAENS, and F. B. SERRANO[1]

Of the Bureau of Science, Manila

THREE PLATES

The tannin-extract industry in the Philippines produces annually about 5,500,000 kilos of solid extract with an estimated value of about 500,000 pesos.[2]

Practically all of this extract comes from bakauan bark (*Rhizophora* spp.) and is known commercially as cutch (super) extract. The mangrove swamps which yield most of these barks are estimated to cover an area of approximately 320,789 hectares.

In the process of cutch manufacture the time that elapses from the felling of the tree and the stripping of the bark to the first leaching ranges from two to four weeks or more. During the transportation by water from the swamps to the cutch factory the barks, which are piled in the hold of the ship, generate heat and exude moisture. Under these conditions the barks usually become infected with molds.

Knudson's[3] experiments showed that in 10 per cent tannic acid solutions only *Aspergillus flavus, Aspergillus niger,* and *Penicillium* sp. were able to grow. Seltzer and Marshall,[4] in their investigation on the loss of tannin from liquors prepared from different tanning materials, used the solid mangrove-bark extract, but they did not state the specific organism causing the loss of tannin.

The object of this investigation was to determine the effect of molds on the tannin content of both the bakauan bark and the cutch solution obtained from it.

The bakauan bark used in this investigation was obtained from a mangrove swamp near Zamboanga through the courtesy

[1] In this investigation the chemical work was done by F. M. Yenko and Luz Baens. The histological study was carried out by F. B. Serrano.

[2] Annual Report of the Insular Collector of Customs, Manila (1934) 274.

[3] Journ. Biol. Chem. 14 (1913) 159.

[4] Journ. Am. Leather Chem. Assoc. 25 (1930) 168.

of the Philippine Cutch Corporation. The bark, immediately after stripping, was dried at 60° C. to expel moisture and then shipped directly to Manila. When it was received in the laboratory, there was no evidence of molds on the bark.

The molds were taken from a large shipment of bark received from Palawan.

The first step in our studies was the isolation and identification of the molds. Only two kinds were isolated and they were identified by descriptions and characteristics recorded in the literature as *Aspergillus niger* Van Tieghem and *Penicillium glaucum* Link.

A description of *A. niger* Van Tieghem is given by Thom and Church [5] as follows:

Stalks smooth; heads in varying shades of fuscous, purplish brown to carbon black; conidia rough or tuberculate from bars or tubercles of brown or purplish brown coloring substance.

The *Aspergillus niger* group, as described by Van Tieghem, is characterized by rapidly growing colonies with abundant submerged colorless mycelium. In some strains, however, yellow color may be found in the hyphæ and in the substratum. Aërial hyphæ are usually scantily produced, but are abundant in age in certain strains.

Aspergillus niger, therefore, is used to designate a whole group of black aspergilli with fundamental characters in common, within which *A. niger* Van Tieghem becomes the typical species of a section falling approximately within the range of detailed characters established by Van Tieghem for the strain used in his fermentation studies.

The following description of *Penicillium glaucum* Link is given by Thom: [6]

Colonies green with a yellow tinge, surface coarse and rough, dense mycelium, spreading slowly, without wrinkles; odor intensely moldy with a suggestion of naphtha, suggestive of rotten oranges, taste of mold in cheese bitter, obnoxious; grows best between 15° and 25° C., poorly above 25° C., and not above 30° C.; liquefies beer wort gelatine in five days at 15° C.; grows fairly well under partly anaërobic conditions where it produces white perithecia in four days without green conidial areas; dissolves casein.

[5] The Aspergilli (1926) 167. [6] The Penicillia (1930) 561.

EXPERIMENTAL PROCEDURE

Aspergillus niger.—The effect of *A. niger* on the tannin content of bakauan bark was determined in the following manner: Pieces of fresh bark, immediately after stripping from the tree, were carefully dried at 60° C. They were then inoculated with spores and placed in a container that allowed the barks to regain their original moisture content. The barks remained in this condition during the period of mold growth.

A representative sample of the fresh bark was analyzed for its original tannin content. The inoculated bark was also analyzed after sixteen weeks of mold growth. Results of the analysis are given in Table 1.

It has been shown that tannic acid is toxic to a large number of fungi at relatively low concentrations.[7] Table 1 shows a marked reduction in the percentage of nontans after inoculation and growth of *A. niger* on bakauan bark. The tannin content, however, was lowered by only 5.15 per cent after a period of four months' growth. The purity increased in spite of a lowering in the tannin content. The results further show a marked reduction in the soluble solids. Even if the tannin content does not appear to be very much affected, the amount of extract that can be obtained from a given weight of bark, will be reduced when *A. niger* grows on it.

To observe the effect of *Aspergillus niger* on bakauan-cutch solution, two solutions of different strengths (2 and 5 per cent tannin content) were prepared and heated on a steam bath for thirty minutes to pasteurize. Two-liter portions of each were separately inoculated with spores of *A. niger*. The tannin content of the solutions was determined before inoculation and periodic analyses were made afterwards.

In selecting aliquot portions of the solutions for analysis, the flasks were rotated gently between the hands in order to get average samples, and care was taken to avoid disturbance of the mold growth on the surface. Evaporation losses were made up with distilled water before samples were taken for analysis. The results are recorded in Tables 2 and 3.

Table 2 shows the effect of *A. niger* on a solution containing 2 per cent tannin. In this solution the mold grew very abundantly. After nine and a half months' growth there was a final

[7] Knudson, L., Journ. Biol. Chem. 14 (1913) 164.

reduction in the tannin content of 27.62 per cent. Most of this reduction appeared to take place after seven months' growth. The insoluble solids increased and the nontans decreased. In this case there was also an appreciable increase in purity.

Although *A. niger* grew abundantly in a tannin concentration of 5 per cent it lowered the original tannin content of the solution by only 1.62 per cent after eleven months' growth as shown in Table 3. There was a slight reduction of nontans and soluble solids and an increase in purity. Apparently the higher concentration of bakauan-cutch solution is not easily deteriorated by the *A. niger* mold. When the same mold grows in a tannin solution of lower concentration, the changes in the solution are more pronounced.

Penicillium glaucum.—In studying the effect of the mold *P. glaucum* on cutch solutions obtained from bakauan bark the experimental procedure employed was the same as that used for studying the effect of the mold *A. niger.* Cutch solutions prepared from the bark were inoculated with spores, and analyzed periodically. The results of the analysis are given in Table 4.

Penicillium glaucum is not as strong a fermentative organism as *A. niger,* for it failed to grow in a cutch solution containing 5 per cent tannin, in which the latter thrived well. In a lower concentration (2 per cent) *P. glaucum* grew abundantly.

The first evidence of deterioration of the 2 per cent solution was the decrease in the percentage of nontans and soluble solids. After nine and a half months' growth in this solution, *P. glaucum* effected a reduction of 32.38 per cent in the original tannin content. At the beginning of the experiment purity gradually increased, but at the end the purity percentage was almost the same as the original.

All of these results show that the deterioration of bakauan bark is not easily effected by the two molds that have been found to attack tannin in its more concentrated solutions. It is also apparent that *A. niger* is a much more active organism than *P. glaucum.* When *A. niger* grows on bakauan bark, there is always a possibility that there will be some loss in the yield of extract.

To determine the possible changes in the color of the leather tanned with solutions infected with these molds, sheepskin skivers were tanned with solutions having a concentration of 0.4 per cent tannin for each mold. The colors of the leathers

obtained were compared with Ridgway's [8] color standards as shown below.

Kind of solution.	Color of skiver.
Bakauan-cutch solution obtained from Philippine Cutch Corporation. (Standard solution containing no molds.)	Light reddish cinnamon to reddish cinnamon.
Extract of bakauan bark infected with *A. niger*. (Bark with 4 months' mold growth.)	Light reddish cinnamon.
Bakauan-cutch solution infected with *A. niger*. (Solution with 9.5 months' mold growth.)	Brownish yellow to dull brick red.
Bakauan-cutch solution infected with *P. glaucum*. (Solution with 9.5 months' mold growth.)	Reddish brown.

Skins tanned with standard cutch solution gave very nearly the same results as those tanned with extract of bakauan bark infected with *A. niger* (4 months' mold growth).

When the skins were tanned with bakauan-cutch solutions containing *A. niger* or *P. glaucum* (9.5 months' mold growth) the color of the leather was somewhat different from the color obtained by tanning with standard cutch solution.

HISTOLOGICAL STUDY OF THE DETERIORATION OF BAKAUAN BARK DUE TO MOLDS

To observe further the effect of the growth of *A. niger* on bakauan bark and to study the extent to which this mold embeds itself in the bark and deteriorates the tissues, the following histological studies were made.

Both normal and moldy bakauan barks were cut into cubic blocks having sides about 1 centimeter in length. The blocks were boiled separately in tap water for an hour to expel air bubbles and then soaked in concentrated hydrofluoric acid for softening purposes. Vials coated inside with paraffin were used as containers. A month later the blocks were soft enough to section. They were removed from the acid, washed in running water for two days, dehydrated through a series of alcohol treatments, cleared in xylol, mounted in paraffin, and then cut with a rotary microtome into serial sections having a thickness of 5 microns. With Mayer's albumen fixative the sections were mounted securely on clean glass slides, cleared of paraffin by dipping in xylol for a minute or two, washed several times with

[8] Color Standards and Color Nomenclature. Washington (1912).

alcohol, and stained with a combination of Bismarck brown and methyl violet. After the necessary dehydration and clearing, the sections were finally mounted in Canada balsam.

Microscopical examinations of these microtome sections showed the cells (Plate 1) of the normal bark to be rigid and compact in contrast to the disintegrated cells (Plate 2) of the moldy bark. Staining with a combination of Bismarck brown and methyl violet rendered the mycelial threads of the mold *A. niger* a deep violet color that distinguished them from the bark tissues which had a light violet to a brownish yellow color (Plate 3).

As shown by the microphotographs the fungus hyphæ usually follow the latex tubes. This indicates that the mold attack is directed mainly against the latex and only partly against the cell walls. Perhaps the starch, sugar, and magnesium salts contained in the latex serve as the principal attraction for the molds. The molds apparently affect the binding materials in the cells and thus the infected tissues are disintegrated. The antiseptic property of the tannin in the latex is evidently not sufficiently potent to retard the mold growth. These observations are in agreement with the results obtained from the chemical tests.

SUMMARY

The two molds *Aspergillus niger* and *Penicillium glaucum* were the only ones found growing on Philippine bakauan bark.

The mold *A. niger* was found to disintegrate the tissues of bakauan bark, but it did not seem to affect materially the composition of the extract obtained from it.

Tanning extracts were made from bakauan bark, infected with the mold *A. niger,* and also from bark that was not moldy. These different extracts gave leathers of about the same color.

Bakauan extract containing 5 per cent tannin is not attacked by the mold *P. glaucum* and is only slightly affected by *A. niger*.

Dilute bakauan extracts containing 2 per cent tannin are attacked by the molds *A. niger* and *P. glaucum* only after prolonged exposure.

The growth of hyphæ along the latex tubes indicates that the mold attack is directed mainly against the latex and only partly against the cell walls. These observations are in agreement with the results obtained from the chemical tests.

TABLE 1.—*Analyses of normal bakauan bark and bakauan bark inoculated with Aspergillus niger.*

Date of analysis.	Tannin.	Non-tannin.	Purity.[c]	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
October 31, 1935 [a]	33.99	13.37	71.77	----------	54.26	47.36	6.90
March 4, 1935 [b]	32.24	11.10	74.39	—5.15	53.28	43.34	9.94

[a] Before inoculation.
[b] After inoculation.
[c] The purity is obtained by dividing the percentage tannins by the percentage soluble solids and multiplying the result by 100.

TABLE 2.—*Analyses of bakauan-cutch solution inoculated with Aspergillus niger.*

Date of analysis.	Tannin.	Non-tannin.	Purity.	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
October 29, 1934 [a]	2.10	0.81	72.16	----------	2.94	2.91	0.03
November 22, 1934 [b]	2.26	0.64	77.93	+ 7.62	2.94	2.90	0.04
January 9, 1935 [b]	2.25	0.50	81.82	+ 7.14	2.80	2.75	0.05
February 19, 1935 [b]	2.24	0.52	81.16	+ 6.67	2.78	2.76	0.02
June 17, 1935 [b]	2.04	0.48	80.95	— 2.86	2.57	2.52	0.05
August 12, 1935 [b]	1.52	0.40	79.17	—27.62	2.07	1.92	0.15

[a] Before inoculation. [b] After inoculation.

TABLE 3.—*Analyses of bakauan-cutch solution inoculated with Aspergillus niger.*

Date of analysis.	Tannin.	Non-tannin.	Purity.	Variation from original tannin content.	Solids.		
					Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
September 10, 1934 [a]	4.95	1.56	76.04	----------	6.63	6.51	0.12
September 18, 1934 [b]	5.07	1.52	76.93	+2.42	6.69	6.59	0.10
September 26, 1934 [b]	5.02	1.56	76.29	+1.41	6.63	6.58	0.05
October 18, 1934 [b]	4.99	1.12	81.67	+0.81	6.18	6.11	0.07
October 24, 1934 [b]	5.04	1.36	78.75	+1 82	6.41	6.40	0.01
November 7, 1934 [b]	5.11	1.30	79.72	+3.23	6.45	6.41	0.04
December 5, 1934 [b]	5.08	1.25	80.25	+2.63	6.39	6.33	0.06
February 19, 1935 [b]	5.13	1.02	83.41	+3.64	6.29	6.15	0.14
April 4, 1935 [b]	5.21	1.09	82.70	+5.25	6.33	6.30	0.03
June 17, 1935 [b]	5.01	1.18	80.94	+1.22	6.32	6.19	0.13
August 12, 1935 [b]	4.87	1.10	81.58	—1.62	6.21	5.97	0.24

[a] Before inoculation. [b] After inoculation.

TABLE 4.—*Analyses of bakauan-cutch solution inoculated with Penicillium glaucum.*

Date of analysis.	Tannin.	Non-tannin.	Purity.	Variation from original tannin content.	Solids.		
					Total.	Soluble.	In-soluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
October 29, 1934 [a]	2.10	0.81	72.16	----------	2.94	2.91	0.03
November 22, 1934 [b]	2.31	0.58	79.93	+10.00	2.93	2.89	0.04
January 9, 1935 [b]	2.26	0.59	79.30	+ 7.62	2.85	2.85	0.00
February 19, 1935 [b]	2.26	0.54	80.71	+ 7.62	2.86	2.80	0.06
June 17, 1935 [b]	1.84	0.78	70.23	—12.38	2.68	2.62	0.06
June 26, 1935 [b]	1.62	0.99	62.07	—22.86	2.74	2.61	0.13
August 12, 1935 [b]	1.42	0.56	71.72	—32.38	2.28	1.98	0.30

[a] Before inoculation. [b] After inoculation.

ILLUSTRATIONS

[All the microscopic sections were stained with a combination of Bismarck brown and methyl violet.]

PLATE 1

FIG. 1. Longitudinal section of normal bakauan bark (*Rhizophora* spp.) showing rigidity and compactness of cells.

2. Cross section of normal bakauan bark showing the same rigidity and compactness of cells as illustrated in the longitudinal section.

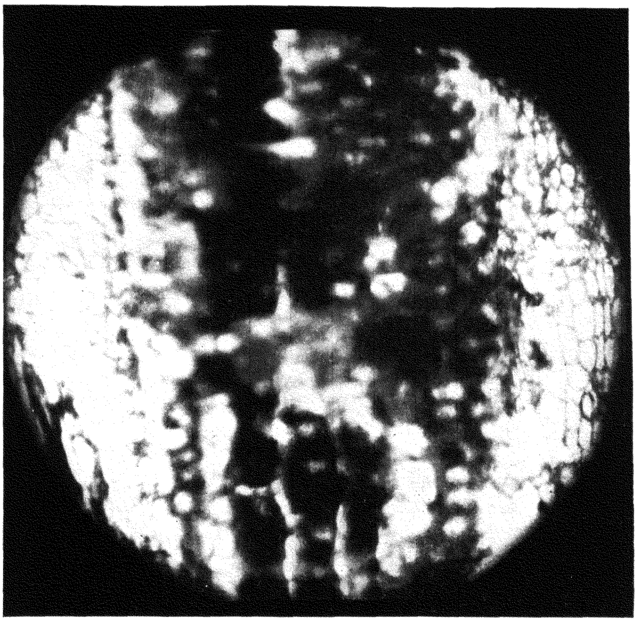
PLATE 2

FIG. 1. Longitudinal section of bakauan bark infested by the mold *Aspergillus niger.* The section shows disintegration of cells due to mold action.

2. Cross section of bakauan bark infested by the mold *A. niger.* Disintegration of cells by mold action is even more pronounced than in the longitudinal section of the infested bark.

PLATE 3

Longitudinal section (fig. 1.) and cross section (fig. 2.) of bakauan bark infested with the mold *A. niger.* These sections are more highly magnified than those represented in Plate 2. They show fungus mycelia represented by dark filamentous and branched structures. The fungus filaments are deep violet, while the bark tissues are brownish yellow to light violet.



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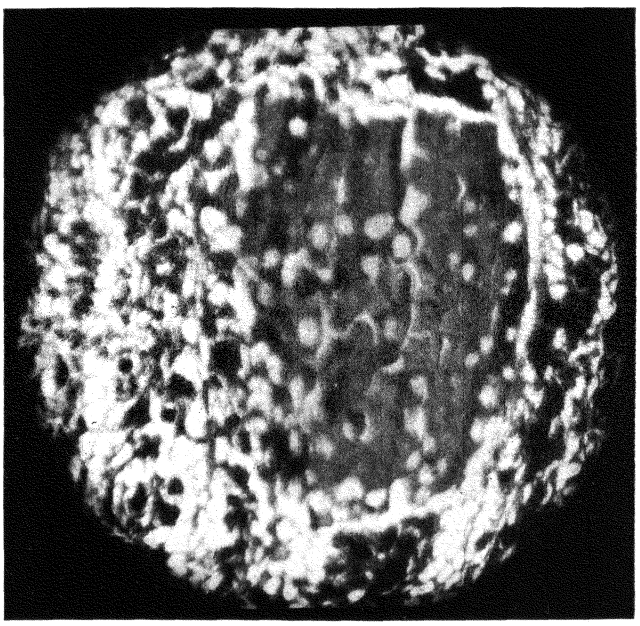

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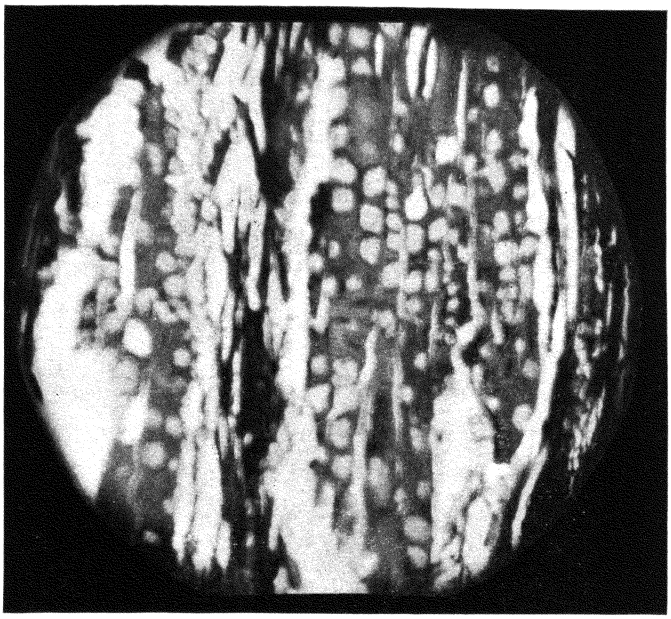
PLATE 1.



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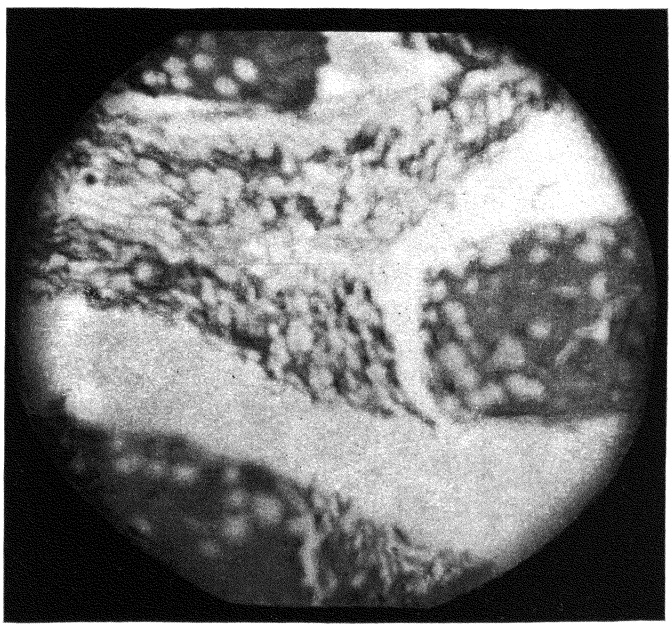

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PLATE 2.

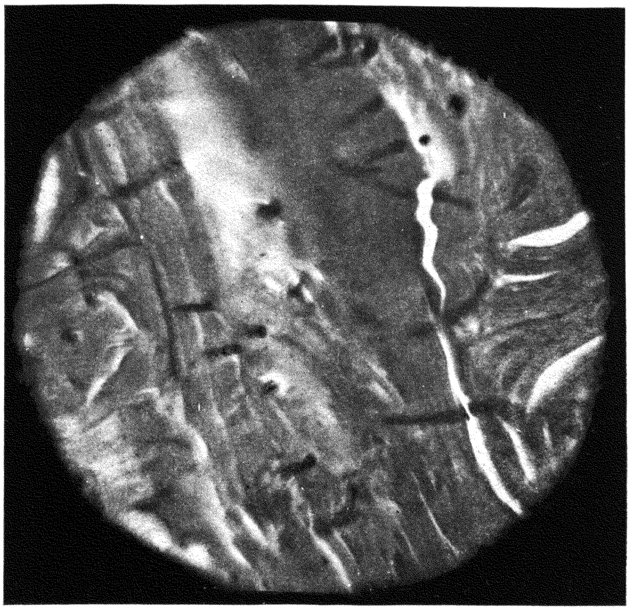

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PLATE 3.

THE INTERRELATIONS OF COMPRESSIBILITY, MELTING POINT, SOLUBILITY, VALENCE, AND OTHER PROPERTIES OF THE HALIDES OF THE ALKALI AND ALKALINE EARTHS.[1]

By SOFRONIO BALCE

Of the Department of Chemistry, University of the Philippines, Manila

From already known data(1) it seems possible to represent by simple formulas the relations between constants, which have been hitherto expressed in a more or less complicated manner.

The compressibilities of some halides, for instance, can be calculated from the equation

$$K = \frac{V_2}{5.6 \times 10^{12} Z} \qquad (1)$$

where K is the compressibility; V_2, molecular volume of the solid; and Z, valence. Born(3) calculates his values from the heats of ionization and formation and other properties. Table 1 shows Born's values and Table 2, those calculated from equation 1.

In passing it may be mentioned that 5.6×10^{12} (instead of 1.33×10^{5}) would be the value of the constant used in an equation given in a previous work,(2) if the heat of formation is given in ergs. The equation referred to is

$$H = 1.33 \times 10^5 Z \sqrt[3]{\triangle V} \qquad (2)$$

where H is the heat of formation in calories; $\triangle V$, shrinkage in volume per unit volume incident to compound formation; and Z, valence.

Hildebrand's(5) comparison of calculated and observed values of solubility is given in Table 3. However, using a simple relation

$$Sn = \frac{(5.7 - P)^3}{10} \qquad (3)$$

gives solubilities, Sn, that are closer to observed values. P is the electrolytic decomposition potential. It may be mentioned that 5.7 is the constant used by the writer(2) in relating the volume shrinkage with the electrolytic decomposition potential as follows:

$$P = 5.7 \sqrt[3]{\triangle V} \qquad (4)$$

[1] Read before the Third Philippine Science Convention, February 26, 1935.

Fajans,(4) in pointing out the relation of melting point to the size of molecules, offers the comparison shown in Table 5. Table 6 is the comparison based on volume shrinkage, the equation being

$$Tm = 15 \times 10^2 \sqrt[3]{\triangle V} \tag{5}$$

where Tm is the melting point. This constant may also be calculated from the heat of formation thus:

$$Tm = \frac{1.13 \times 10^{-2} H}{Z} \tag{6}$$

The values calculated from this are given in Table 7.

Another simple relation, obtained by combining equations 2 and 4, is

$$H = 2.333 \times 10^4 ZP \tag{7}$$

Results from this equation are given in Table 8.

TABLE 1.—*Compressibility calculated by Max Born, as estimated from his graph.*

	Calculated.	Observed.
NaCl	3.4×10^{-12}	4.2×10^{-12}
NaBr	4.7	5.1
NaI	6.3	7.1
KCl	5.3	5.7
KBr	6.6	6.7
KI	8.7	8.6
TlCl	4.8	4.8
TlBr	5.3	5.1
TlI	6.8	6.7

TABLE 2.—*Compressibility as calculated from molecular volume (equation 1).*

	$\frac{V_2}{Z}$	Calculated.	Observed.
LiF	9.97	1.8×10^{-12}	1.5×10^{-12}
LiCl	20.51	3.6	3.5
LiBr	25.21	4.5	4.3
LiI	32.95	5.9	[a] 5.9
NaF	15.18	2.7	[a] 2.07
NaCl	26.96	4.8	4.2
NaBr	34.14	6.1	5.1
NaI	40.66	7.3	7.1
KF	23.43	4.2	3.3
KCl	37.43	6.7	5.7
KBr	43.28	7.7	6.7
RbCl	43.09	7.7	7.4
$CaCl_2$	25.79	4.6	4.4
$CaBr_2$	29.81	5.3	4.8

[a] P. W. Bridgman, Proc. Am. Acad. Arts and Sci. 67 (1932) 345–375.

TABLE 3.—*Solubility in Mol fraction as calculated by Hildebrand compared with observed values.*

	Calculated.	Observed.
$AgNO_3$	26×10^{-2}	16×10^{-2}
$NaClO_3$	8	15
HgI_2	11	0.0002
KNO_3	21	6.3
$NaNO_3$	10	16
$K_2Cr_2O_7$	18	18
AgCl	13	0.00002
$PbCl_2$	6	0.067
KCl	1	8.8

TABLE 4.—*Solubility in grams per cubic centimeters as calculated from equation 4.*

Solute.	Calculated.	Observed.
LiF	0.05	0.0027
NaCl	0.4	0.36
NaBr	0.7	0.80
NaI	1.6	1.6
KCl	0.3	0.29
KBr	0.5	0.53
$CaCl_2$	0.6	0.60
CaI_2	2.0	1.92
$SrCl_2$	0.4	0.44
$BaCl_2$	0.3	0.31

TABLE 5.—*Fajan's indication of parallelism of size with melting and boiling points.*

	NaF	CaO
Lattice distance	2.31 A	2.38 A
Melting point	997°	2,572°
Boiling point	1,695°	2,850°

TABLE 6.—*Relation between volume shrinkage $\triangle V$ and melting point (equation 6).*

	$\sqrt[3]{\triangle V}$	Tm Calculated.	Tm Observed.
LiI	0.528	7.5×10^2	7.2×10^2
NaF	0.856	12.9	12.7
NaBr	0.67	10.1	10.4
KBr	0.726	10.9	10.0
KI	0.626	9.4	9.5
$CaCl_2$	0.673	10.1	10.5
$CaBr_2$	0.600	9.0	9.5
$SrCl_2$	0.724	10.9	11.4
SrI_2	0.511	7.7	7.8

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TABLE 7.—*Relation between the heat of formation and melting point as calculated from equation 7.*

	H	Tm Calculated.	Tm Observed.
LiI	65×10^3	7.4×10^2	7.2×10^2
NaF	109	12.3	12.7
NaCl	98	11.1	10.8
KI	80	9.0	9.5
$CaCl_2$	190	10.7	10.5
$SrCl_2$	198	11.1	11.4
$SrBr_2$	171	9.7	9.0
SrI_2	136	7.7	7.8

TABLE 8.—*Relationship between heat of formation and electrolytic decomposition potential P.*

	P	Heat of formation. $2.333 \times 10^4\ PZ$	Heat of formation. Observed.
LiCl	4.3	1.00×10^5	1.20×10^5
NaF	4.6	1.07	1.09
KF	4.8	1.12	1.18
KCl	4.3	1.00	1.06
KBr	4.0	0.93	0.95
KI	3.5	0.82	0.80
RbF	4.7	1.10	1.08
RbCl	4.3	1.00	1.05
RbBr	4.0	0.93	0.96
$MgCl_2$	2.9	1.35	1.51
$CaCl_2$	3.9	1.82	1.90
$CaBr_2$	3.6	1.67	1.55
CaI_2	3.0	1.40	1.27
BaF_2	4.7	2.19	2.23
$BaCl_2$	4.2	1.96	1.97
$BaBr_2$	3.9	1.82	1.72

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TREMATODE PARASITES OF PHILIPPINE VERTEBRATES, VIII

FLUKES FROM A COBRA AND A CROCODILE

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THREE PLATES

Family ACANTHOSTOMIDÆ Poche, 1925

ACANTHOSTOMUM ELONGATUM sp. nov. Plate 1.

This species is represented by a large number of specimens collected from a crocodile. According to Looss (1899), the members of the genus *Acanthostomum* are parasites of fishes and reptiles. The trematode in question is easily distinguished from its relatives reported from fishes (*A. spiniceps, A. absconditus, A. imbutiformis,* and *A. præteritus*) by its very elongated shape and the posterior extent of its vitellaria, which do not reach the level of the ovary. It has, therefore, to be compared only with the remaining member of the genus; namely, *A. coronarium* (Cobbold, 1861), which is also a parasite of crocodiles. According to the brief description of *A. coronarium* given by Cobbold, the Philippine species differs from it in being much larger and in having twenty-one cephalic spines instead of fourteen.[1]

Description.—Body very elongate, with rounded or slightly attenuated extremities, 10.8 to 16.3 millimeters in length by 0.50 to 0.85 millimeter in maximum breadth. Cuticle armed with spines from anterior end to level in front of ovary; the spines are thickly set anteriorly, sparse posteriorly. Oral sucker well-developed, terminal, funnel-shaped, 0.30 to 0.32 by 0.34 to 0.42 millimeter in size, with twenty-one cephalic spines arranged in a single row and measuring 65 to 77 by 19 to 27 microns. Acetabulum very much anterior in position, only a short dis-

[1] Looss (1901) did not find the number of cephalic spines constant in the species of *Acanthostomum* described by him. In *A. elongatum,* however, as well as in another new member of the genus to be described below, the number of these spines has been found to be almost constant.

tance behind oral sucker, 0.30 to 0.36 by 0.31 to 0.36 millimeter in size. Pharynx measures 0.17 to 0.24 by 0.13 to 0.17 millimeter, separated from oral sucker by a prepharynx 0.17 to 0.26 millimeter long; œsophagus practically absent; intestinal cæca long, narrow, reaching to near posterior end of body.

Testes tandem, oval, postovarial, near posterior end of body; anterior testis 0.34 to 0.57 by 0.22 to 0.45, posterior testis 0.30 to 0.47 by 0.22 to 0.32 millimeter in size. Seminal vesicle long, free in parenchyma, in transverse coils between uterine coils and acetabulum. Common genital pore median, immediately preacetabular, leading into a moderately developed sinus.

Ovary oval, immediately pretesticular, to one side of median line, 0.24 to 0.38 by 0.19 to 0.32 millimeter in size. Receptaculum seminis prominent, between ovary and first testis; Laurer's canal present. Shell gland diffuse, to one side of median line opposite ovary. Uterus very long, in transverse coils confined between intestinal cæca and extending from in front of ovary to acetabulum. Vitellaria in small follicles, occupying lateral sides of body from near junction of anterior and middle thirds of body length to a short distance in front of level of ovary. Eggs numerous, thick-shelled, yellowish, operculated, with developed miracidia, 26.8 to 32.6 by 15.3 to 17.2 microns in size.

Excretory bladder roomy, opens exteriorly through a posteroterminal excretory pore.

Specific diagnosis.—*Acanthostomum:* Body very elongate, 10.8 to 16.3 by 0.50 to 0.85 millimeters in size. Cephalic spines twenty-one, 65 to 77 by 19 to 27 microns in size. Vitellaria from near junction of anterior and middle thirds of body length to a short distance in front of ovary. Eggs with developed miracidia, 26.8 to 32.6 by 15.3 to 17.2 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 474.

ACANTHOSTOMUM ATÆ sp. nov. Plate 2, fig. 1.

Specimens of this fluke were collected from the same host in which *A. elongatum* was found. It was thought in the beginning that it represented a small variety of *A. elongatum,* but a detailed comparison between the two forms showed several specific differences, especially as to size, the number of cephalic spines, and the position of the vitellaria. As a matter of fact the tre-

matode in question bears a closer resemblance to *A. spiniceps* (Looss, 1901) than to *A. elongatum* in the three characters mentioned. It may be distinguished from *A. spiniceps* by its smaller oral sucker, its shorter prepharynx and œsophagus, and its smaller and more anteriorly located acetabulum.

Description.—Body elongate, anterior end truncate, posterior end rounded, 4.1 to 5.5 millimeters in length by 0.3 to 0.5 millimeter in maximum breadth. Cuticle armed with minute spines from anterior end to level of ovary; spines thickly set anteriorly, sparser posteriorly. Oral sucker well-developed, terminal, funnel-shaped, 0.17 to 0.32 by 0.22 to 0.32 millimeter in size, provided with 25 to 26 cephalic spines arranged in a single row and measuring 50 to 58 by 13 to 14 microns. Acetabulum near junction of anterior and second fourths of body length, 0.12 to 0.18 by 0.12 to 0.19 millimeter in size. Prepharynx 0.20 to 0.30 millimeter long; pharynx 0.12 to 0.15 by 0.08 to 0.13 millimeter in size; œsophagus very short, dividing immediately into two intestinal cæca that reach to near posterior end of body.

Testes subglobular, postovarial, near posterior end of body, one immediately behind the other and touching; anterior testis 0.20 to 0.25 by 0.19 to 0.23, posterior testis 0.26 to 0.30 by 0.19 to 0.22 millimeter in size. Seminal vesicle free in parenchyma, coiled, occupying a median position between acetabulum and anterior level of vitelline glands. Common genital pore median, immediately preacetabular, leading to moderately developed genital sinus.

Ovary oval, immediately pretesticular, slightly to one side of median line, 0.24 to 0.28 by 0.17 to 0.21 millimeter in size. Receptaculum seminis large, between ovary and first testis; Laurer's canal present. Shell gland diffuse, small, to one side of median line opposite seminal receptacle. Uterus long, in transverse coils between cæca and extending from in front of ovary to acetabulum. Vitellaria in small follicles occupying lateral sides of body from junction of second and third fourths of body length to level of anterior testis. Eggs numerous, thick-shelled, yellowish, operculated, with developed miracidia, 30.7 to 34.5 by 15.3 to 17.2 microns in size.

Excretory bladder roomy, opens exteriorly through a posteroterminal excretory pore.

Specific diagnosis.—*Acanthostomum:* Body elongate, 4.1 to 5.5 by 0.3 to 0.5 millimeters in size. Cephalic spines 25 to 26 (in the large majority of cases 26) in number, 50 to 58 by 13 to 14 microns in size. Vitellaria from near junction of second

and third fourth of body length to anterior testis. Eggs with developed miracidia, 30.7 to 34.5 by 15.3 to 17.2 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 500.

Family CLINOSTOMIDÆ Luehe, 1901

HARMOTREMA EUGARI sp. nov. Plate 3, fig. 1.

Specimens of this parasite were presented for determination by Dr. C. M. Africa and Dr. E. Y. Garcia, of the School of Hygiene and Public Health, University of the Philippines.

The genus *Harmotrema* is represented by two species of trematodes parasitic in reptiles; namely, *H. infecundum* Nicoll, 1914, from a West African water snake and *H. laticaudæ* Yamaguti, 1933, from *Laticauda laticaudata* in Japan. The fluke in question is closely related to *H. laticaudæ,* but differs from it in the smaller size of its testes and ovary and in the distribution of its vitellaria, the greater bulk of which occurs in the intercæcal space.

Description.—Body elongate, rounded at both ends, its lateral borders more or less parallel; measures 1.9 to 4.0 millimeters in length by 0.5 to 0.7 millimeter in maximum width. Cuticle unarmed. Oral sucker weak, subterminal, 0.07 to 0.09 by 0.06 to 0.09 millimeter in size; prepharynx absent; pharynx 0.06 to 0.07 millimeter in diameter; œsophagus 0.03 to 0.08 millimeter long; intestinal cæca small in diameter, near median line, reach to near posterior end of body. Acetabulum weak, 0.09 to 0.12 millimeter in diameter, near middle of anterior third of body length or 0.5 to 0.7 millimeter from anterior end of body.

Testes oval, tandem, postequatorial, separated from each other by a space longer than the length of either testis; anterior testis 0.17 to 0.23 by 0.13 to 0.17, posterior testis 0.19 to 0.28 by 0.10 to 0.15 millimeter in size. Cirrus sac large, oval, preëquatorial, lying obliquely between intestinal cæca immediately in front of first testis; measures 0.28 to 0.38 by 0.13 to 0.19 millimeter and incloses a large seminal vesicle, pars prostatica and a protrusible cirrus. The latter is globose to club-shaped, thickly covered with needlelike spines 15 to 23 microns long. Genital pore

ventral to left intestinal cæcum, 0.4 to 0.7 millimeter from acetabulum or 1.0 to 1.5 millimeters from anterior end of body.

Ovary oval, intertesticular, usually nearer to and in contact with second testis; measures 0.12 to 0.17 by 0.10 to 0.15 millimeter. Receptaculum seminis absent, the oviduct being enlarged in diameter and probably serving as seminal receptacle at the same time. Laurer's canal present, opens dorsally opposite anterior level of ovary. Shell gland not prominent, between ovary and vitelline reservoir; latter almost as large as and dorsal to ovary. Vitelline glands in the form of small follicles, mostly confined within intercæcal space and extending from immediately behind acetabulum to blind terminations of intestinal cæca. Uterus very short, leads into a prominent metraterm measuring 0.14 to 0.19 by 0.08 to 0.11 millimeter. Eggs few, yellowish, operculated, 108 to 115 by 69 to 77 microns in size.

Main excretory system similar to that of *H. laticaudæ*, as described by Yamaguti (1933). It consists of four longitudinal excretory vessels, one on each side of an intestinal cæcum. A short distance behind the œsophageal bifurcation the two vessels on each side unite into a single canal that extends anteriorly as far as the base of the oral sucker; posteriorly the same vessels also unite, the common trunk thus formed meeting its fellow at the excretory pore. The latter is posteroterminal in position.

Specific diagnosis.—Harmotrema: Body 1.9 to 4.0 by 0.5 to 0.7 millimeters in size. Cirrus sac preëquatorial, 0.25 to 0.38 by 0.13 to 0.19 millimeter in size. Cirrus globose to club-shaped, thickly covered with needlelike spines 15 to 23 microns long. Common genital opening ventral to left cæcum, 1.0 to 1.5 millimeters from anterior end. Vitellaria in the form of a band, occupying most of intercæcal space not otherwise occupied by other organs from immediately behind acetabulum to termination of intestinal cæca. Eggs few, 105 to 115 by 69 to 77 microns in size.

Host.—Snake (*Naja* sp.).

Location.—Intestine.

Locality.—Biñan, Laguna, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 490.

HARMOTREMA RUDOLPHII sp. nov. Plate 3, fig. 2.

This trematode agrees with the members of the genus *Harmotrema* in the general arrangement of the reproductive organs,

the position of the genital pore, and the structure of the main excretory system. It differs from them in being less elongate; in the more posterior position of the acetabulum, testes, and ovary; and in the more profuse development of the vitellaria.

Description.—Body elongate-oval, 1.9 to 2.2 millimeters in length by 0.6 to 0.7 millimeter in maximum breadth across cirrus pouch or in front of that level. Cuticle unarmed. Oral sucker subterminal, weak, 0.04 to 0.06 by 0.03 to 0.06 millimeter in size; prepharynx absent, pharynx 0.04 to 0.05 millimeter in diameter; œsophagus 0.07 to 0.12 millimeter long; intestinal cæca reach to near posterior end of body. Acetabulum weak, 0.13 to 0.15 millimeter in diameter, near middle of second fourth of body length.

Testes globular to oval, tandem, near posterior end of body; first testis 0.28 to 0.29 by 0.23 to 0.29, second testis 0.20 to 0.30 by 0.20 to 0.26 millimeter in size. Cirrus sac large, immediately postequatorial, 0.34 to 0.56 by 0.20 to 0.25 millimeter in size; incloses large seminal vesicle, pars prostatica, and protrusible cirrus. The latter is moderately long and provided with numerous small spines. Common genital pore ventral to left intestinal cæcum, near middle of third fourth of body length or 0.8 to 1.0 millimeter from posterior end of body.

Ovary oval, sometimes triangular in outline, to right side of median line in intertesticular zone, forming with testes a sort of triangle; measures 0.14 to 0.17 by 0.12 to 0.17 millimeter. Receptaculum seminis absent, Laurer's canal present. Shell gland submedian, between ovary and second testis. Vitellaria profuse, occupying most of space not otherwise occupied by other organs from slightly in front of acetabular level to posterior end of body; the anterior portion of the body in which the vitelline glands do not occur is distinguished by its lighter color. Uterus short, leads into prominent metraterm; latter immediately behind cirrus sac and measures 0.30 to 0.38 by 0.08 to 0.13 millimeter. Eggs few, yellowish, operculated, 109 to 133 by 69 to 77 microns in size.

Main excretory system very similar to that of *H. eugari*. Excretory pore posteroterminal.

Specific diagnosis.—Harmotrema: Body elongate-oval, 1.9 to 2.2 by 0.6 to 0.7 millimeters in size. Cirrus sac postequatorial, 0.34 to 0.56 by 0.20 to 0.25 millimeter in size. Common genital opening in third fourth of body length, 0.6 to 1.0 millimeter from posterior end of body. Vitellaria profuse, occupying most of

space not otherwise occupied by other organs from immediately in front of acetabular level to posterior end of body. Eggs few, 109 to 133 by 69 to 77 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 491.

Family ALARIIDÆ Tubangui, 1922

NEODIPLOSTOMUM CROCODILARUM sp. nov. Plate 2, fig. 2.

This is the second member of the genus *Neodiplostomum* Railliet, 1919, to be reported from the Philippines, the first one being *N. aluconis* Tubangui, 1933, from an owl. The genus, as defined by Dubois (1935), includes the following other strigeid trematodes: *N. spathula* (Creplin, 1829); *N. spathulaforme* (Brandes, 1891); *N. siamense* (Poirier, 1886); *N. poirieri* Dubois, 1932; *N. gavialis* Narain, 1930; *N. longum* (Brandes, 1891); *N. ellipticum* (Brandes, 1891); *N. bifurcatum* (Wedl, 1861); *N. pseudospathula* (Brandes, 1891); *N. cochleare* (Krause, 1914); *N. grande* (Diesing, 1850); *N. attenuatum* von Linstow, 1906; *N. kashmirianum* Faust, 1927; *N. pseudattenuatum* (Dubois, 1927); *N. morchelloides* Semenow, 1927; *N. fungiloides* Semenow, 1927; and *N. impræputiatum* Dubois, 1934. The trematode in question most closely resembles the first five of the parasites enumerated above in the relative lengths of the anterior and posterior body regions and in the presence of papillalike structures in the holdfast organ. In *N. crocodilarum,* however, the number of papillæ in the holdfast organ is from 25 to 35, in *N. siamense* 40, and in *N. gavialis* 70; in *N. spathula* and *N. spathulaforme* the number of the papillæ is not given in the available literature. The Philippine species may further be differentiated from its near relatives by the distribution of its vitelline glands.

Description.—Body with a total length of 4.2 to 5.2 millimeters, divided distinctly into two regions. Forebody more or less conical, flattened dorsoventrally, 2.3 to 2.7 millimeters in length by 0.80 to 0.95 millimeter in maximum diameter; hindbody more or less cylindrical, 1.8 to 2.6 millimeters in length by 0.60 to 0.85 millimeter in maximum diameter. Oral sucker terminal, 0.04 to 0.06 by 0.05 to 0.06 millimeter in size; prepharynx absent; pharynx 0.04 to 0.05 by 0.03 to 0.04 millimeter in size; œsophagus

0.06 to 0.11 millimeter long; intestinal cæca narrow in diameter, reach to near posterior end of body. Acetabulum weak, 0.09 to 0.11 by 0.10 to 0.13 millimeter in size, immediately behind junction of first and second thirds of length of forebody. Holdfast organ more or less elliptical, 0.85 to 1.15 by 0.30 to 0.50 millimeters in size, in posterior half of forebody, possesses an elliptical opening and its inner border shows the presence of 25 to 35 prominent papillalike structures. A definite adhesive gland, as seen in other strigeid trematodes, is lacking; in its place are a few intensely staining cells dorsal to the holdfast organ.

Testes large, tandem, postovarial, in middle third of hindbody length; anterior testis measures 0.48 to 0.58 by 0.55 to 0.78, posterior testis 0.50 to 0.70 by 0.57 to 0.80 millimeter. Vesicula seminalis much coiled, immediately behind second testis. A well-developed bursa not apparent. Genital pore dorsoterminal at posterior end of hindbody, opening into a roomy genital atrium. Latter is guarded dorsally by a muscular, conical prolongation of the hindbody.

Ovary roundish to oval, at middle of anterior third of hindbody length, 0.19 to 0.24 by 0.19 to 0.30 millimeter in size. Uterus short, reaches anteriorly to near junction between cephalic and caudal body regions and then bends posteriorly as a more or less straight tube leading to common genital pore. Shell gland and vitelline reservoir between testes, the former on the left and the latter on the right of median line. Laurer's canal narrow in diameter, wavy in outline, opens on the dorsal surface opposite anterior border of first testis. Vitellaria moderately developed, extending from immediately or a short distance behind acetabulum to anterior or middle level of first testis; the greater bulk of the glands is found in the forebody, in and around the holdfast organ. Eggs few, yellowish, operculated, thin-shelled, 104 to 120 by 54 to 65 microns in size.

Excretory system of the typical holostome type, the median and the two lateral excretory vessels being very conspicuous in the forebody. Excretory pore ventro-subterminal at posterior end.

Specific diagnosis.—Neodiplostomum: Body 4.2 to 5.2 millimeters in total length, distinctly divided into two regions; forebody 2.3 to 2.7 by 0.80 to 0.95, hindbody 1.8 to 2.6 by 0.60 to 0.85 millimeters in size. Holdfast organ with 25 to 35 papilla-like structures. Vitellaria from immediately or a short distance

behind acetabulum to anterior or middle level of first testis. Eggs few, 104 to 120 by 54 to 65 microns in size.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Intestine.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 475.

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ILLUSTRATIONS

PLATE 1

Acanthostomum elongatum sp. nov., entire worm, ventral view.

PLATE 2

FIG. 1. *Acanthostomum atæ* sp. nov., entire worm, ventral view.
2. *Neodiplostomum crocodilarum* sp. nov., entire worm, ventral view.

PLATE 3

FIG. 1. *Harmotrema eugari* sp. nov., entire worm, ventral view.
2. *Harmotrema rudolphii* sp. nov., entire worm, ventral view.

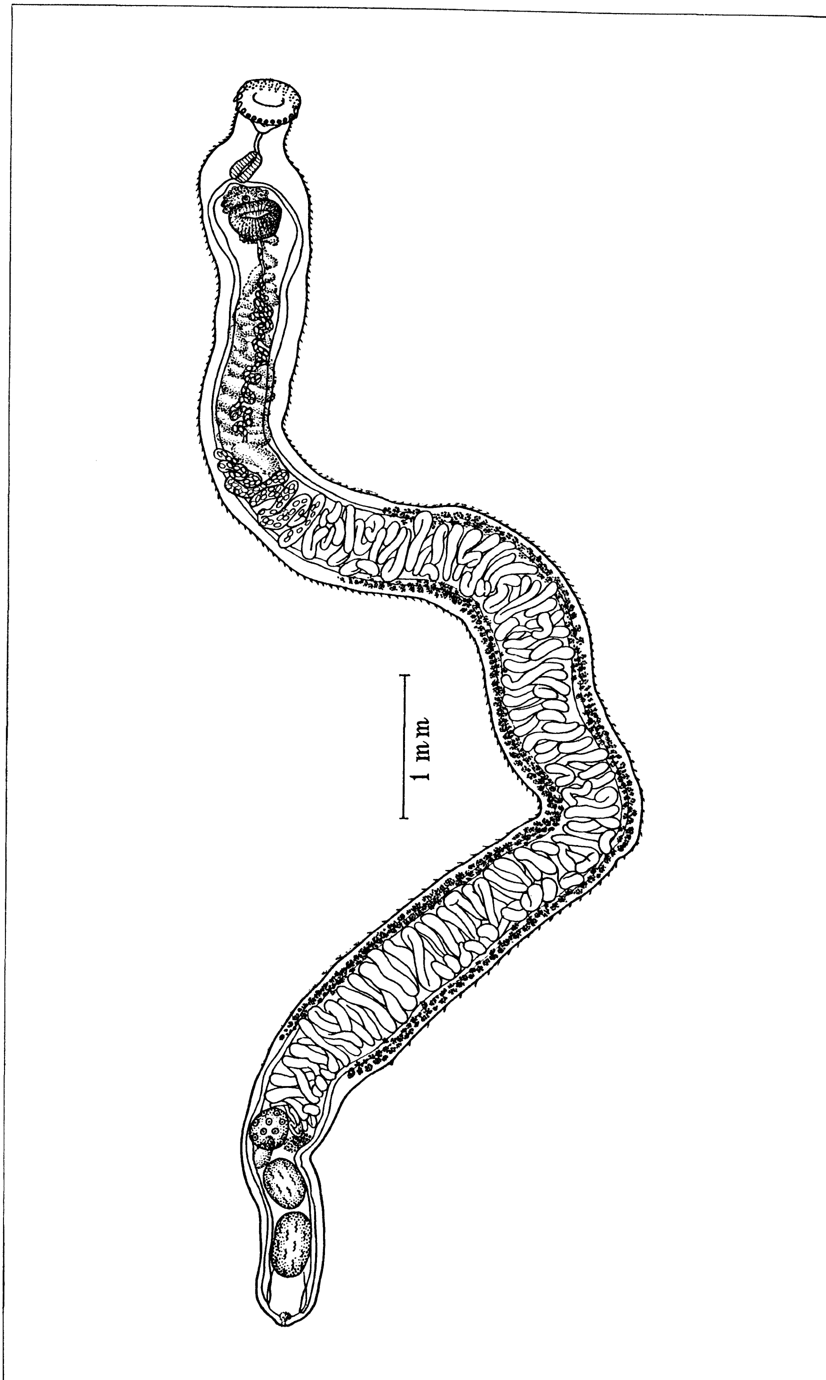

PLATE 1.

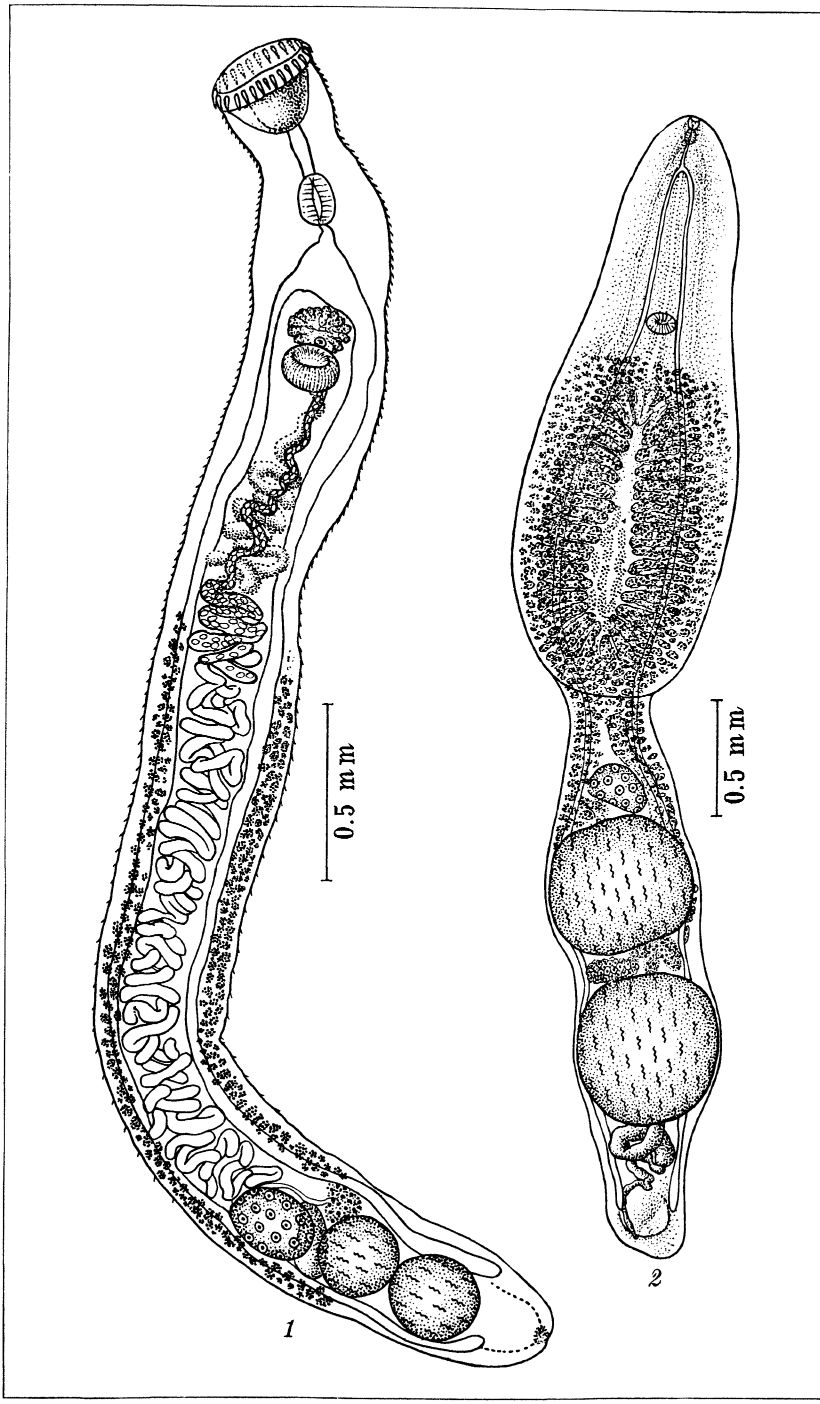

PLATE 2.

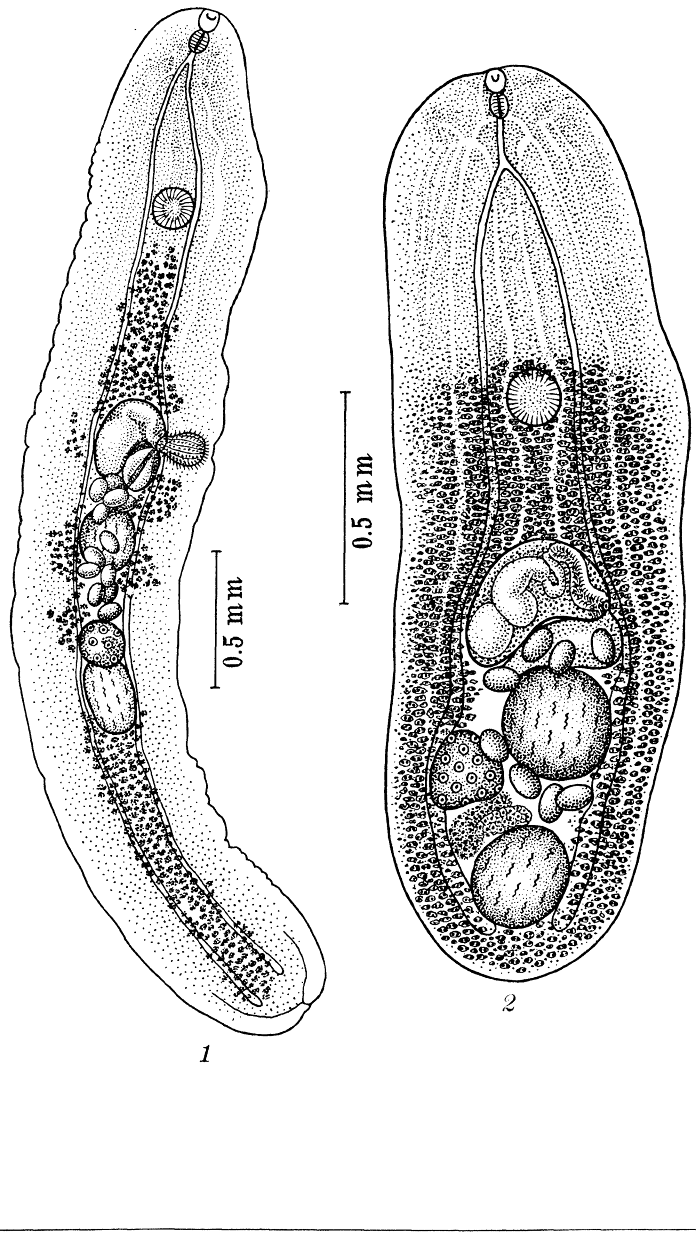

PLATE 3.

THE PLEURAL HAIRS OF CULICINE MOSQUITO LARVÆ

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FOUR PLATES

INTRODUCTION

The pleural hairs of mosquito larvæ consist of three paired groups of four hairs each, lying ventrolaterally on the thorax. The four hairs of each group all arise from a single chitinized tubercle, which facilitates their recognition. In an entire mounted larva it can be seen that each pair of groups arises in proximity to the imaginal discs of the legs of the corresponding segment of the thorax, and it is believed that these groups of hairs, in fact, represent the last remnant of the legs of the larva.

Although incidental descriptions of the pleural hairs of certain *Anopheles* larvæ were given by Martini (1923) and Root (1924), Puri (1928) first pointed out the great value of the pleural hairs in classifying the larvæ of the Indian species of *Anopheles* into natural groups. This is particularly true as regards the larvæ of the subgenus *Myzomyia*, which includes the dominant anophelines of the tropical part of the Old World. Root (1931) recently examined the pleural hairs of the anopheline larvæ of the New World and found that the group distinctions based on the pleural hairs are much less clearly marked in the larvæ of the subgenera *Anopheles* and *Nyssorhynchus*.

Practically nothing has been published on the pleural hairs of the larvæ of culicine mosquitoes. It seemed worth while, therefore, to undertake a systematic examination and description of the pleural hairs of all the culicine larvæ represented in the collection of Dr. F. M. Root, professor of medical entomology of Johns Hopkins University, in order to see what light these structures would throw on the relationships of the genera and subgenera, and if characters of use for classification and identification could be discovered. This investigation was suggested to me by Doctor Root and carried on under his direction and super-

vision. I acknowledge my indebtedness to him for many helpful suggestions and criticisms during the progress of the work, as well as for considerable assistance in the interpretation of my results and in the writing of this paper.

TERMINOLOGY

The groups of pleural hairs are segmentally arranged on the thorax, so that they may be naturally termed the prothoracic, mesothoracic, and metathoracic groups. In order to abbreviate these terms, the prothoracic group may be called "group I;" the mesothoracic group, "group II;" and the metathoracic group, "group III."

Careful examination of the origin of the four hairs of a single group or the sockets left when they are removed shows that the four hairs may be divided into two pairs, an anterior and a posterior, each containing two hairs, one dorsal and the other ventral. The four hairs, then, may be conveniently spoken of as "the anterior ventral" (or briefly av), "the anterior dorsal" (ad), "the posterior ventral" (pv), and "the posterior dorsal" (pd). If it is desired to refer to one particular hair, the group number is prefixed to one of these abbreviations, to indicate the group to which the hair belongs; thus, "I–ad" refers to the anterior dorsal hair of the prothoracic group.

In describing the hairs briefly, it is desirable to indicate both their comparative length and their mode of branching. Since in many genera the entire prothoracic group is very small in comparison with the other two, it seems best to describe the length of each hair by a rough comparison with the longest hair of the particular group to which it belongs. Hairs that are equal to or not much shorter than the longest hair of the group are termed simply "long." Hairs that are from one-half to three-quarters as long as the longest hair are called "fairly long." Hairs about one-fourth or one-third as long as the longest hair are called "short," while those that are much less than one-fourth as long as the longest hair are referred to as "very short." If such a very short hair is stout and spinelike, instead of slender and flexible, it is called a "spine."

Puri (1928), in a study of the mode of branching of the pleural hairs, has shown that in the Indian *Anopheles* larvæ the long pleural hairs may be either "single;" that is, entirely without branches; "split" about the middle of their length into a small number of branches; or "feathered," having a series of short

lateral branches on each side of the hair. In culicine larvæ all the hairs, including the pleural hairs, are apt to bear a large number of delicate lateral branches, which might lead one to refer to them as feathered. It seems best, however, to ignore these delicate lateral branches, and in this paper hairs that possess only such branches will be referred to as "single."

Hairs that are "split," much as in the anopheline larvæ, are sometimes found in culicines, also, but the mode of branching of the pleural hairs that is most characteristic of the culicines is a splitting of the hair at its extreme base into a variable number of branches, which all lie in the same plane, like the sticks of a fan, producing a flat, fan-shaped tuft. Where the number of branches is small, such hairs are called "double, triple, 4-branched," or "5-branched," but when there are six or more branches the tuft is simply referred to as a "fan." In a few larvæ, belonging to subgenera addicted to tree holes and similar breeding places, one of the prothoracic pleural hairs is divided at its base into a number of (usually) short branches, arising in a clump and projecting in different directions, thus forming a "stellate tuft," much like many others in different locations on the thorax and the abdomen of such larvæ. In *Megarhinus* one pleural hair in each group is much thicker than the others and covered with spinelike projections. This type of hair is called "stout spinose."

In the names of species and their allocation to genera and subgenera, Dyar's Mosquitoes of the Americas (1928) has been followed, except in a few instances where changes were obviously necessary.

To facilitate rapid reference to the number of long hairs in the different groups of pleural hairs, the number of long or fairly long hairs in each group is written, beginning with the prothoracic group, with the numbers representing the long hairs in the different groups separated by dashes. This is called the "formula" for that species or genus. Thus, the formula for *Anopheles* is 3–2–2, indicating that there are three long hairs in the prothoracic group, two in the mesothoracic group, and two in the metathoracic group.

GENERAL SURVEY OF THE PLEURAL HAIRS OF CULICINE LARVÆ

The detailed descriptions of the pleural hairs of the larvæ examined in the course of this study will be found in a table at the end of this paper. In the body of the paper will be taken

up only a general survey of the variations undergone by the various groups and hairs and then as applied to the recognized classificatory divisions of tribes, groups, genera, and, in some cases, subgenera.

REDUCTION IN SIZE OF THE ENTIRE PROTHORACIC GROUP OF PLEURAL HAIRS

In some of the mosquito larvæ, particularly those of the Anophelini, *Megarhinus, Theobaldia, Wyeomyia,* and *Limatus,* the pleural hairs of the prothoracic group are of practically the same size as those of the other groups. In most of the culicines, however, the prothoracic group is definitely smaller than the others; and in some—such as, *Aëdeomyia, Orthopodomyia,* most species of *Culex* and *Aëdes,* and the subgenus *Psorophora*—the prothoracic pleural hairs are less than half as large as those of the other groups.

THE NUMBER OF LONG OR FAIRLY LONG HAIRS IN EACH GROUP

In *Anopheles,* as Puri (1928) and Root (1931) have pointed out, there are three long hairs in the prothoracic group and two each in the mesothoracic and metathoracic groups, giving the formula 3–2–2. Root (1931) has shown that in *Chagasia* the formula is 3–2–3, which may perhaps be looked upon as more primitive than that of *Anopheles,* since one may presume that originally all four hairs were of equal length, as is the case in the prothoracic and mesothoracic groups of *Dixa.* In the majority of culicine larvæ the formula is 3–3–2, although there are many exceptions, as will be noted later.

VARIATIONS OF THE PLEURAL HAIRS

In general, the prothoracic group is much the most variable one, while the mesothoracic group shows very little variation and the metathoracic group only slightly more.

Of the individual hairs the anterior dorsal hair usually shows the greatest variation and is the most highly specialized. This hair is particularly likely to assume the shape of a fan, especially in the mesothoracic and metathoracic groups.

The anterior ventral hair, also, shows a certain amount of variation and specialization in the prothoracic group, although it is usually long and single in the mesothoracic and metathoracic groups.

The two hairs of the posterior pair exhibit comparatively little variation. The posterior ventral is almost always single, and

is usually long in the prothoracic and mesothoracic groups, short in the metathoracic group.

The posterior dorsal is always short, often very short, and relatively inconspicuous except in certain sabethine larvæ, where it assumes the form of a spine. It is not improbable that this hair is absent altogether at times, but its small size makes it very difficult to be sure of this, without access to more plentiful and better-preserved material than that examined by me.

THE PROTHORACIC GROUP OF PLEURAL HAIRS

In the culicine larvæ, the prothoracic group of pleural hairs is the most significant and valuable for classificatory purposes. Several different groups can be distinguished on this basis.

In *Megarhinus* the three long hairs of the group are all single, but I–ad is stout and spinose. In *Aëdeomyia* the size of the whole prothoracic group is greatly reduced, but the three long hairs are all single and of about the same length.

In the great majority of the American sabethine genera both I–av and I–ad are more or less branched. The amount of this branching ranges from a double hair to a fan with a considerable number of branches. In some groups the two hairs are branched alike, in others the anterior dorsal has a greater number of branches than the anterior ventral. In the subgenera *Melanolepis* and *Decamyia* (both placed in *Dendromyia* by Dyar) hair I–pv is also slightly branched, but in the majority of sabethines it is a long single hair. In *Wyeomyia*, subgenera *Nunezia* and *Dodecamyia*, none of the long prothoracic hairs is branched, in decided contrast to the other forms examined. The hair I–pd is always small, but is spinelike in *Goeldia* and *Isostomyia magna*, also in the subgenera *Dinomyia* and *Melanolepis*. In *Joblotia* I–av is single, though I–ad is branched.

Among the true culicine genera there are a few that have the anterior dorsal prothoracic pleural hair branched. In *Uranotænia* (American species) it is usually double, and in *Orthopodomyia* it forms a fan. In the subgenus *Psorophora* all three of the long prothoracic hairs are split into a number of branches at about the middle of their length.

In the remaining culicine mosquitoes hair I–pv is invariably long and single; hairs I–av and I–ad are usually single, but vary considerably in length in different genera. Three groups may be distinguished on this basis. In *Aëdes* (subgenera *Ochlerotatus, Aëdimorphus,* and *Stegomyia*), *Psorophora* (subgenus

Grabhamia), and in *Theobaldia inornata* both I–av and I–ad are fairly long. This is also the case in *Aëdes* (*Finlaya*) *atropalpus* and *fluviatilis*. In most species of the subgenera *Finlaya* and *Howardina* of *Aëdes*, however, hair I–av is fairly long and single while hair I–ad is branched, varying from a short double or triple hair in *Finlaya* to a short stellate tuft or a fairly long 4-branched hair in species of *Howardina* and in *Hæmagogus*. In *Aëdes* (*Aëdes*) *cinereus*, also, hair I–ad is double or triple and fairly long.

In certain species of *Culex* (mainly species breeding in water held by plants and belonging to the subgenera *Carrollella, Melanoconion,* and *Microculex,* but also including *Culex corniger*) hair I–ad is fairly long, while hair I–av is short. This condition is also found in *Deinocerites cancer,* in *Theobaldia dyari* and *melanura,* and in *Psorophora,* subgenus *Janthinosoma.*

In most species of *Culex,* in *Mansonia,* and in *Psorophora* (*Grabhamia*) *discolor* both hairs I–ad and I–av are short, leaving I–pv as the only really long hair in the prothoracic group.

THE MESOTHORACIC GROUP OF PLEURAL HAIRS

The characteristic arrangement of the hairs of this group, throughout the whole culicine series, is for hairs II–av and II–pv to be long and single while hair II–ad is branched (usually forming a fan) and II–pd is very short, as usual.

Variations from this type are not very numerous. In *Megarhinus* the hairs of the mesothoracic group agree precisely with those of the prothoracic group; that is, the three long hairs are single and II–ad is stout and spinose. In *Aëdeomyia* the description of the mesothoracic group reads much like that of the prothoracic group, hairs II–av and II–ad being long and single and II–pv fairly long and single, but in actual length these long hairs vastly exceed those of the prothoracic group and they show short spiny side branches very different from the usual delicate ones.

While hair II–ad is usually developed into a definite fan, there are many species, especially among the sabethines, where this fan has only two, three, or four branches. This is the case in all species of *Joblotia, Wyeomyia, Dendromyia,* and *Limatus* examined, except in the subgenera *Wyeomyia* and *Dodecamyia,* where this hair is single. In *Goeldia, Isostomyia,* and *Sabethoides* it is definitely fanlike.

In *Mansonia,* also, II–ad is rather few-branched, often triple, and in *Aëdes* (*Stegomyia*) *ægypti* it is double in all the larvæ I have examined.

Peculiarly enough, while the mesothoracic group is absolutely normal and usual in the subgenera *Grabhamia* and *Janthinosoma* of *Psorophora,* in the subgenus *Psorophora* it varies decidedly from the usual type. Here II–ad is long and single, II–av varies from short and split into a number of branches to fairly long and split into two branches, while II–pv is fairly long and single in some species and short and split in others.

Throughout the whole series of larvæ examined, hair II–pd is uniformly very short and is developed into a spine only in *Goeldia, Isostomyia,* and the subgenera *Dinomyia* and *Melanolepis.*

THE METATHORACIC GROUP OF PLEURAL HAIRS

Here again the majority of the culicines conform to a general type, in which III–av is long and single, III–ad is branched (usually a fan), III–pv is short and usually single, and III–pd is very short.

Megarhinus and *Aëdeomyia* are exceptions, as usual. In *Megarhinus* the metathoracic group is essentially like the other two groups, III–ad being stout and spinose, although in this group III–pv is shorter than in the others and can only be called fairly long. In *Aëdeomyia* III–ad is long and single, but III–pv is short and single, as in the usual type.

As was the case in the mesothoracic group, a number of species, mainly sabethines, have hair III–ad few-branched, although the branching is of the fanlike type. This is true of *Joblotia, Limatus,* and *Wyeomyia* (subgenera *Wyeomyia, Phyllozomyia,* and *Pentemyia*); of *Dendromyia* (*Dinomyia*) *mystes,* among the sabethines; and of *Mansonia, Aëdes* (*Stegomyia*) *ægypti,* and *Aëdes* (*Ochlerotatus*) *hastatus* among the true culicines.

In a few groups, among both sabethines and culicines, hair III–pv is long or fairly long instead of short, although it remains single. This variation occurs in *Culex* (subgenus *Mochlostyrax*), in *Psorophora* (subgenera *Grabhamia* and *Janthinosoma*) among the culicines, and in *Joblotia* and *Wyeomyia* (*Pentemyia*) *bromeliarum* among the sabethines.

Hair III–pd is always very short, and is developed into a spine in *Joblotia digitata, Goeldia,* and *Isostomyia,* and in all species of *Dendromyia* examined with the possible exception of *Den-*

dromyia (*Dinomyia*) *mystes*. In *Dendromyia* (*Calladimyia*) *melanoides* this spine is three-pointed, and in the species of *Dendromyia* (*Decamyia*) it is unusually large.

As is true in the mesothoracic group, the pleural hairs of the metathoracic group in *Psorophora* (*Psorophora*) do not conform to the usual type. Again hair III–pd is long and single, while III–av is about half the length of III–ad and is sometimes single, sometimes split into two or three branches. Hair III–pv is short and split into a small number of branches.

VARIATIONS IN THE PLEURAL HAIRS AS RELATED TO CLASSIFICATORY GROUPS

The tribes and groups used in the classification of mosquito genera are still in a somewhat unsatisfactory state, two systems being employed; one, by Dyar, considers only the American mosquitoes, the other, by Edwards, deals with the mosquitoes of the whole world. Both of these authorities, however, are agreed upon the same general grouping of the genera, and differ mainly as to whether certain sets of genera should be called groups or tribes. These two arrangements, together with a list of the American genera considered in this paper which are placed in the various groups, are given in Table 1.

TABLE 1.—*Tribes and groups of mosquitoes and the American genera considered in this paper.*

Classification of—		Genera.
Edwards.	Dyar.	
Tribe Anophelini	Tribe Anophelini	*Anopheles, Chagasia.*
Tribe Megarhinini	Tribe Megarhinini	*Megarhinus.*
Tribe Culicini:		
Uranotænia group	Tribe Uranotænini	*Uranotænia.*
Sabethes group	Tribe Sabethini	*Sabethoides, Wyeomyia.*
	Tribe Culicini	*Dendromyia, Limatus, Goeldia, Isostomyia, Joblotia.*
	Aëdeomyia group	*Aëdeomyia.*
Theobaldia-Mansonia group	Orthopodomyia group	*Orthopodomyia.*
	Theobaldia-Mansonia group	*Theobaldia, Mansonia.*
Aëdes group	Aëdes group	*Aëdes, Psorophora, Hæmagogus.*
Culex group	Culex group	*Culex, Lutzia, Deinocerites.*

Naturally enough, since this study deals almost exclusively with American mosquito larvæ, the classification of Dyar is found to correspond best with my results and will be followed

in the tabulation of tribal and group characters based on the pleural hairs which follows.

It is to be remembered, of course, that the following statements of characters are based entirely on the examination of a rather limited series of species of purely New World origin, so that they will undoubtedly require modification after other workers have studied more material, especially from the Old World.

1. Tribe Anophelini. With two long hairs in the mesothoracic group (hair II–pv short).
   - Genus *Anopheles*. Two long hairs in the metathoracic group (hair III–pv short).
   - Genus *Chagasia*. Three long hairs in the metathoracic group (hair III–pv long).
2. Tribe Megarhinini (only a single genus, *Megarhinus*). Three long hairs in each group, hair ad of each group stout and spinose.
3. Tribe Uranotænini (only a single American genus, *Uranotænia*). Prothoracic group with only two long hairs, of which one (hair I–ad) is few-branched.
4. Tribe Sabethini. The majority of the species examined can be distinguished from all other American mosquito larvæ by the presence of two long branched hairs (I–av and I–ad) in the prothoracic group. Exceptions to this rule are *Joblotia*, with only one long branched hair, and *Wyeomyia* (subgenera *Nunezia* and *Dodecamyia*) with none.
   - Genus *Joblotia*. Three long hairs in the metathoracic group; only one long branched hair in the prothoracic group.
   - Genera *Goeldia* and *Isostomyia*. Two long hairs in the metathoracic group; two long branched hairs in the prothoracic group; hair pd of all groups a spine.
   - Genus *Dendromyia* (subgenus *Dinomyia*). Same as *Goeldia* and *Isostomyia*.
   - Genus *Dendromyia* (subgenus *Melanolepis*). Same as *Goeldia* and *Isostomyia*, except that there are three long branched hairs in the prothoracic group.
   - Genus *Dendromyia* (subgenera *Calladimyia* and *Heliconiamyia*). Same as *Goeldia* and *Isostomyia* except that hair pd is converted into a spine only in the metathoracic group.
   - Genus *Dendromyia* (subgenus *Decamyia*). Same as *Calladimyia* and *Heliconiamyia*, except that there are three long branched hairs in the prothoracic group.
   - Genus *Wyeomyia* (subgenus *Phyllozomyia*, plus *W. longirostris*). Formula 3–3–2; two long branched hairs in the prothoracic group, one in each of the other groups.
   - Genus *Wyeomyia* (subgenus *Wyeomyia*, excluding *W. longirostris*). Same as *Phyllozomyia*, except that there is no long branched hair in the mesothoracic group.
   - Genus *Wyeomyia* (subgenus *Pentemyia*). Same as *Phyllozomyia*, except that there are three long hairs in the metathoracic group (formula 3–3–3).

Genus *Wyeomyia* (subgenus *Dodecamyia*). Same as *Phyllozomyia*, except that there is no long branched hair in either prothoracic or mesothoracic group.

Genus *Wyeomyia* (subgenus *Nunezia*). Same as *Phyllozomyia*, except that the prothoracic group has only two long hairs (formula 2–3–2), neither of which is branched.

Genus *Limatus*. Same as *Phyllozomyia*.

Genus *Sabethoides*. Same as *Phyllozomyia*, except that both of the long branched hairs of the prothoracic group are definite fans.

NOTE.—Although the American sabethine genera show many variations, as can be seen from the tabulation just given, the basic formula is evidently 3–3–2 and the most common condition as to long branched hairs shows two in the prothoracic group and one in each of the other groups.

5. Tribe Culicini. With three long hairs in the mesothoracic group (only one in subgenus *Psorophora*) and with one, two, or three long hairs in the prothoracic group, all usually single. The typical formulæ, then, are 1, 2, or 3–3–2, with one fan in each of the mesothoracic and metathoracic groups.

Aëdeomyia group (genus *Aëdeomyia*). Formula 3–3–2; none of the long hairs branched.

Orthopodomyia group (genus *Orthopodomyia*). Formula 3–3–2; one long branched hair ("fan") in each group.

Theobaldia-Mansonia group.

Theobaldia inornata. Same as *Aëdes* (*Ochlerotatus*), below (formula 3–3–2).

Theobaldia dyari and *melanura*. Same as *T. inornata* except that hair I–av is short (formula 2–3–2).

Mansonia. Same as typical *Culex*, below (formula 1–3–2).

Aëdes group.

Aëdes (subgenera *Ochlerotatus*, *Aëdimorphus*, and *Stegomyia*). Formula 3–3–2; one branched hair in the mesothoracic and one in the metathoracic group.

Aëdes (subgenera *Finlaya* and *Howardina* and *Aëdes cinereus*). Same as above except that hair I–ad is usually branched and is often short.

Hæmagogus. Same as *Aëdes* (*Finlaya* and *Howardina*).

Psorophora (subgenus *Grabhamia*). Hair III–pv fairly long, making the formula 3–3–3.

Psorophora (*Grabhamia*) *discolor*. I–av and I–ad short, formula 1–3–3.

Psorophora (subgenus *Janthinosoma*). I–av short, III–pv long, formula 2–3–3.

Psorophora (*Janthinosoma*) *cyanescens*. I–av fairly long and double, formula 3–3–3.

Psorophora (subgenus *Psorophora*). Formula usually 3–3–2. One long single hair in the mesothoracic, and one in the metathoracic, group. All the other fairly long hairs split into several branches beyond base.

Culex group.

Culex (subgenera *Culex, Choeroporpa,* and pool-dwelling *Melanoconion*). In the normal series of *Culex* species which inhabit permanent ground pools, only one hair of the prothoracic group is long (hair I–pv), giving the formula 1–3–2.

Culex [subgenera *Carrollella,* and *Microculex*, species of *Melanoconion* living in water held by plants, and *C.* (*Culex*) *corniger*]. Hair I–av is fairly long, giving the formula 2–3–2.

Culex (subgenus *Mochlostyrax*). Hair III–pv is fairly long, giving the formula 1–3–3.

Deinocerites. Hair I–ad long; formula 2–3–2.

THE PLEURAL HAIRS OF THE OLD WORLD CULICINE LARVÆ

Since pleural hairs of the larvæ, either New or Old World species, play such an important rôle in entomological studies, an examination of the Old World species at this point is not out of place and a few of the possibilities may be discussed. It is obvious that the number of Old World species examined is small and requires further study, but for the moment, and until further work definitely establishes a fact to the contrary one may compare them with the results obtained with the related American species as follows:

Genus *Culex.* Species examined, *Culex* (*Culex*) *sitiens, Culex* (*Culex*) *pacificus,* and an unidentified larva evidently belonging to *Culex* (*Lophoceratomyia* or *Culiciomyia*). These all had the formula 1–3–2, agreeing with the normal series of American *Culex* larvæ.

Genus *Lutzia. Lutzia tigripes.* Although *Lutzia* is sometimes considered only a subgenus of *Culex,* this species had the aëdine formula 3–3–2, both I–av and I–ad being fairly long and single. A skin of the American *Lutzia brasiliæ* was also examined. All the prothoracic pleural hairs had been broken off, but from the appearance of their sockets it seemed probable that its formula would be the same as that of the Old World species.

Genus *Aëdes.* Three species were examined.

Aëdes (*Stegomyia*) *variegatus* had the typical aëdine formula, 3–3–2, and hair I–ad was fairly long and single, as in *Aëdes ægypti.* The "fans" of the mesothoracic and metathoracic groups were much better developed than in the latter species, where they are only double.

Aëdes (*Finlaya*) *albilabris* agreed with most of the American species of *Finlaya* in having hair I–ad short and branched (double in this case). Otherwise it was typically aëdine.

Aëdes (?) *albolineatus* is of especial interest because it does not fit well into the subgeneric classification of *Aëdes.* It is usually placed in *Stegomyia* with a question mark. The coloration of the adult

agrees with *Stegomyia*, the male hypopygium is partly like *Stegomyia*, partly like *Aëdimorphus*, and the male palpi are unusually short for either of these subgenera, yet not short enough to throw it into *Aëdes* or *Skusea*. To add to the confusion, the pleural hairs of the larva prove to be most like those of *Finlaya* or *Howardina*, I–ad being fairly long, but branched into a stellate tuft, like others on the thorax and abdomen of this larva.

Genus *Rachionotomyia*. This is a genus of Old World sabethines, believed by Edwards to be nearest to *Goeldia* of the American forms. Two species were examined, *R. caledonica* and an unidentified species closely related to it, both from the New Hebrides. In both, the pleural hairs were exactly like those of *Orthopodomyia*, the formula being 3–3–2, with one long fan in each of the groups. This does not agree exactly with the pleural hairs of any of the numerous types found among the American sabethines.

Genus *Uranotænia*. Only one species, *U. quadrimaculata*, was examined. The pleural hairs of this species differ very decidedly from the uniform type presented by the five species of American *Uranotænia* examined. This can be seen best by direct comparison, as given below.

American *Uranotænia*. Formula 2–3–2. I–ad double; II–ad and III–ad fans.

Uranotænia quadrimaculata. Formula 1–2–2. None of the long hairs branched.

Unless the specimens examined were defective, which seemed not to be true, this would indicate that a study of the pleural hairs of other species of Old World *Uranotænia* might be of value in grouping the species into subgenera.

GENERAL DISCUSSION

This study was not undertaken with any idea that the pleural hairs would offer characters which would supersede those already in use for the identification of culicine larvæ. The genera of culicine mosquitoes are so well marked, in the larvæ, by the characters of the air tube, pecten, and comb that no further characters are necessary for their satisfactory identification. It was hoped, however, that the pleural hairs might be of assistance in classification; that is, in determining the position of the different genera in a natural evolutionary series. It must be admitted that, in the material examined, no natural series can be traced, in its entirety, although the pleural hairs do offer certain suggestive possibilities.

In order to decide which genera of the Culicinæ are the more primitive, in respect to the pleural-hair characters, it is necessary to decide what characteristics are to be considered primitive. An examination of a few examples of the other subfamilies included by most authorities in the Culicidæ, shows that in most of the genera of the Chaoborinæ (in *Eucorethra*, *Corethra*, and

Chaoborus, at least) the pleural hairs are either absent or cannot be located. In certain species of *Dixa* (subfamily Dixinæ), on the other hand, the prothoracic group contains four very long hairs, the mesothoracic group four short hairs, and the metathoracic group two short hairs, none of them branched.

With a decision based partly on the conditions exhibited by *Dixa* and partly on general theoretical considerations, it may be suggested that, in the first place, unbranched hairs represent a more primitive condition than branched ones; second, that primitively all the pleural hairs were long, as in *Dixa*, and that the shortening of certain hairs represents specialization; and, third that originally each of the three groups had the same composition as the others, so that differences between the different groups are the result of specialization.

In none of the Culicinæ do we find any group of pleural hairs with four hairs of equal length, like the prothoracic and mesothoracic groups of *Dixa*. Hair pd is invariably short or very short in all the forms examined. The most primitive condition as to length of the pleural hairs that one can expect, then, is that in which each group contains three long hairs. This condition is found in *Joblotia* and *Wyeomyia* (*Pentemyia*) *bromeliarum* in the sabethines and in *Megarhinus* and *Psorophora* (*Grabhamia*) among the culicines.

The cases in which all of the long pleural hairs are unbranched are also few in number. They occur in *Chagasia* and the more primitive species of *Anopheles*, also in *Megarhinus* and *Aëdeomyia* (and in *Uranotænia quadrimaculata*) among the culicines. The nearest approach to this condition among the sabethines is in *Wyeomyia* (*Dodecamyia*), which has only a single one of the pleural hairs (III–ad) branched. The fact that this subgenus also exhibits a very simple type of clasper in the male hypopygium, while practically all of the other subgenera of *Wyeomyia*, *Dendromyia*, etc., have very complex and highly modified claspers, suggests that this may really be a primitive group.

The only genera in which all three groups of pleural hairs have essentially the same composition are *Megarhinus* and *Joblotia*.

The evidence from the pleural hairs, then, suggests that *Megarhinus* is the most primitive of all the forms examined. From this point on there appear to be at least three distinct lines of development, one leading through *Chagasia* to *Anopheles* and characterized especially by the presence of only two long hairs

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined.*

PROTHORACIC GROUP OF PLEURAL HAIRS.

Tribe, genus, and species.	I-av.	I-ad.	I-pv.	I-pd.
AMERICAN SPECIES				
Tribe Anophelini				
Genus *Chagasia* Cruz (after Root)	Long, single	Long, single	Long, single	Short.
Genus *Anopheles* Meigen (after Puri and Root)	do	do Long split Long feathered	do	Do.
Tribe Megarhinini				
Genus *Megarhinus* Robineau-Desvoidy:				
M. septentrionalis Dyar and Knab	do	Long stout spinose	do	Do.
M. portoricensis von Roder	do	do	do	Do.
M. trinidadensis Dyar and Knab	do	do	do	Do.
M. neglectus Lutz	do	do	do	Do.
M. purpureus Theobald	do	do	do	Do.
Tribe Culicini				
Culicine group				
Genus *Culex* Linnæus:				
Subgenus *Neoculex* Dyar—				
C. apicalis Adams	Short, single	Short, single	do	Very short.
Subgenus *Culex* Linnæus—				
C. bahamensis Dyar and Knab	do	do	do	Do.
C. duplicator Dyar and Knab	do	do	do	Do.
C. nigripalpus Theobald	do	do	do	Do.
C. chidesteri Dyar	do	do	do	Do.
C. secutor Theobald	do	do	do	Do.
C. mollis Dyar and Knab	do	do	do	Do.
C. salinarius Coquillett	do	do	do	Do.
C. declarator Dyar and Knab	do	do	do	Do.
C. fatigans Wiedemann	do	do	do	Do.

C. pipiens Linnæus	do	do	do	Do.
C. territans Theobald	do	do	do	Do.
C. extricator Dyar and Knab	do	do	do	Do.
C. coronator Dyar	do	do	do	Do.
C. corniger Theobald	do	Fairly long single	do	Do.
Subgenus *Carrollella* Lutz—				
C. bihaicolus Dyar and Nuñez Tovar	do	do	do	Do.
C. iridescens (Lutz)	do	do	do	Do.
Subgenus *Melanoconion* Theobald—				
C. atratus Theobald	do	do	Short single	Do.
C. aikenii (Aiken)	do	do	do	Do.
C. conservator Dyar and Knab	do	do	do	Do.
C. antillum magnorum Dyar	do	do	do	Do.
Subgenus *Microculex* Theobald—				
C. pleuristriatus Theobald	do	Fairly long double	do	Do.
C. chryselatus Dyar and Knab	do	Fairly long single	do	Do.
C. imitator Theobald	do	do	do	Do.
Subgenus *Chæroporpa* Dyar—				
C. inhibitator Dyar and Knab	do	Short single	do	Do.
C. educator Dyar and Knab	do	do	do	Do.
C. innominatus Evans	do	do	do	Do.
C. iolambdis Dyar	do	do	do	Do.
C. elevator Dyar and Knab	do	do	do	Do.
C. phlogistus Dyar	do	do	do	Do.
C. bastagarius Dyar and Knab	do	do	do	Do.
Subgenus *Mochlostyrax* Dyar and Knab—				
C. innovator Evans	do	do	do	Do.
C. hesitator Dyar and Knab	do	do	do	Do.
C. unicornis Root	do	do	do	Do.
C. pilosus Dyar and Knab	do	do	do	Do.
Genus *Deinocerites* Theobald:				
D. cancer Theobald	do	Long, single	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

PROTHORACIC GROUP OF PLEURAL HAIRS—Continued

Tribe, genus, and species.	I–av.	I–ad.	I–pv.	I–pd.
Intermediate group				
Genus *Aëdeomyia* Theobald:				
A. squamipennis (Lynch Arribálzaga)	Long, single	Long, single	Short, single	Very short.
Genus *Mansonia* Blanchard:				
M. humeralis Dyar and Knab	Short, single	Short, single	do	Do.
M. titillans (Walker)	do	do	do	Do
M. indubitans Dyar and Shannon	do	do	do	Do.
Genus *Orthopodomyia* Theobald:				
O. signifera (Coquillett)	Long, single	Long, fan	do	Do.
O. albicosta (Lutz)	do	do	do	Do.
O. fascipes (Coquillett)	do	do	do	Do.
Genus *Theobaldia* Neveu-Lemaire:				
T. inornata (Williston)	do	Long, single	do	Do.
T. dyari (Coquillett)	Short, single	do	do	Do.
T. melanura (Coquillett)	do	do	do	Do.
Aëdine group				
Genus *Aëdes* Meigen:				
Subgenus *Howardina* Theobald—				
A. ioliota Dyar and Knab	Fairly long single	Short stellate tuft	do	Do.
A. busckii (Coquillett)	do	do	do	Do.
A. fulvithorax (Lutz)	do	Fairly long 4-branched	do	Do.
Subgenus *Finlaya* Theobald—				
A. terrens (Walker)	Long, single	Fairly long triple	do	Do.
A. podographiens Dyar and Knab	do	Short, double	do	Do.
A. triseriatus (Say)	Fairly long single	do	do	Do.
A. atropalpus (Coquillett)	Long, single	Fairly long single	do	Do.
A. fluviatilis (Lutz)	do	do	do	Short, single.
A. mediovittatus (Coquillett)	do	Short triple tuft	do	Short triple tuft.

Subgenus *Ochlerotatus* Lynch Arribálzaga—				
A. tæniorhynchus (Wiedemann)	Fairly long single	Fairly long single	do	Short, single.
A. sollicitans (Walker)	do	do	do	Very short.
A. mitchellæ (Dyar)	do	do	do	Do.
A. canadensis (Theobald)	do	do	do	Do.
A. punctor (Kirby)	do	do	do	Do.
A. cantator (Coquillett)	do	do	do	Do.
A. fulvus (Wiedemann)	do	do	do	Do.
A. atlanticus Dyar and Knab	do	do	do	Do.
A. tormentor Dyar and Knab	do	do	do	Do.
A. scapularis (Rondani)	do	do	do	Do.
A. infirmatus Dyar and Knab	do	do	do	Do.
A. angustivittatus Dyar and Knab	do	do	do	Do.
A. nubilus (Theobald)	do	do	do	Do.
A. serratus (Theobald)	do	do	do	Do.
A. tortilis (Theobald)	do	do	do	Do.
A. dupreei (Coquillett)	do	do	do	Do.
A. hastatus Dyar	do	do	do	Do.
Subgenus *Stegomyia* Theobald—				
A. ægypti (Linnæus)	do	do	do	Do.
Subgenus *Aëdimorphus* Theobald—				
A. vexans (Meigen)	do	do	do	Do.
Subgenus *Aëdes* Meigen—				
A. cinereus Meigen	do	Fairly long double or triple	do	Do.
Genus *Psorophora* Robineau-Desvoidy:				
Subgenus *Grabhamia* Theobald—				
P. cingulata (Fabricius)	do	Fairly long single	do	Do
P. columbiæ (Dyar and Knab)	do	do	do	Do.
P. jamaicensis (Theobald)	do	do	do	Do.
P. confinnis (Lynch Arribálzaga)	do	do	do	Do.
P. discolor (Coquillett)	Short single	Short single	do	Do.
Subgenus *Janthinosoma* Lynch Arribálzaga—				
P. cyanescens (Coquillett)	Fairly long double	Long single	do	Do.
P. ferox (Humboldt)	Short single	do	do	Do.
P. lutzii Theobald	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	I-av.	I-ad.	I-pv.	I-pd.
Genus *Psorophora* Robineau-Desvoidy—Continued.				
Subgenus *Psorophora* Robineau-Desvoidy—				
P. lineata (Humboldt)	Fairly long split	Fairly long split	Long split	Very short.
P. cilipes (Fabricius)	do	do	do	Do.
P. howardii Coquillett	do	do	do	Do.
P. ciliata (Fabricius)	do	do	do	Do.
Genus *Hæmagogus* Williston:				
H. splendens Williston	Fairly long single	Short stellate tuft	Long single	Short.
Sabethine group				
Genus *Joblotia* Blanchard:				
J. compressa (Theobald)	Long single	Long 3- or 4-branched	do	Do.
J. digitata (Rondani)	do	do	do	Do.
Genus *Goeldia* Theobald:				
G. lunata (Theobald)	Long double	Long fan	do	Spine.
G. longipes (Fabricius)	Long triple	Long 4- or 5-branched	do	Do.
Genus *Isostomyia* Coquillett:				
I. magna (Theobald)	Long double	Long 3- or 4-branched	do	Do.
Genus *Wyeomyia* Theobald:				
Subgenus *Wyeomyia* Theobald—				
W. longirostris Theobald	Long 2- to 4-branched	Long 2- to 4-branched	do	Very short.
W. quasiluteoventralis (Theobald)	do	do	do	Do.
W. pertinans (Williston)	do	do	do	Do.
W. gaudians Dyar and Nuñez Tovar	do	do	do	Do.
Subgenus *Phyllosomyia* Dyar—				
W. smithii (Coquillett)	do	do	do	Do.
W. celænocephala Dyar and Knab	do	do	do	Do.
Subgenus *Pentemyia* Dyar—				
W. bromeliarum Dyar and Knab	do	do	do	Do.
Subgenus *Nunezia* Dyar—				
W. bicornis (Root)	Long single	Short single	do	Do.

Subgenus *Dodecamyia* Dyar—				
W. quasilongirostris (Theobald)	do	Long single	do	Do.
W. pilicauda Root	do	do	do	Do.
Subgenus *Dinomyia* Dyar—				
W. mystes (Dyar)	Long 2- to 4-branched	Long 2- to 4-branched	do	Spine.
W. bourrouli Peryassú	do	do	do	Do.
Subgenus *Melanolepis* Dyar—				
W. complosa Dyar	Long double	Long fan	Long double	Do.
Subgenus *Heliconiamyia* Dyar—				
W. chalcocephala (Dyar and Knab)	do	Long triple	Long single	Very short.
Subgenus *Calladimyia* Dyar—				
W. melanoides Root	Long 5-branched fan	Long 5-branched fan	do	Do.
Subgenus *Decamyia* Dyar—				
W. pseudopecten (Dyar and Knab)	Long double or triple	Long 4- or 5-branched fan	Long double or triple	Do.
W. felicia Dyar and Nuñez Tovar	do	do	do	Do.
Genus *Limatus* Theobald:				
L. durhamii Theobald	Long double	Long 3- or 4-branched	Long single	Do.
L. asulleptus (Theobald)	do	do	do	Do.
Genus *Sabethoides* Theobald:				
S. purpureus Theobald	Long fan	Long fan	do	Do.
Uranotænia group				
Genus *Uranotænia* Lynch Arribálzaga:				
U. sapphirina (Osten-Sacken)	Long single	Long double	Short single	Do.
U. pulcherrima Lynch Arribálzaga	do	do	do	Do.
U. geometrica Theobald	do	do	do	Do.
U. lowii Theobald	do	do	do	Do.
U. coatzacoalcos Dyar and Knab	do	Long 3- or 4-branched	do	Do.
OLD-WORLD SPECIES				
Lutzia tigripes Grandpré and Charmoy	Fairly long single	Long single	Long single	Do.
Culex (Culex) sitiens Wiedemann	Short single	Short single	do	Do.
Culex (Culex) pacificus Edwards	do	do	do	Do.
Culex (Lophoceratomyia) sp?	do	do	do	Do.
Culex (Lophoceratomyia) sp?	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

PROTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	I-av.	I-ad.	I-pv.	I-pd.
Aëdes (*Finlaya*) *albilabris* Edwards	Fairly long single	Short double	Long single	Very short.
Aëdes (*Stegomyia*) *albolineatus* Theobald	do	Fairly long stellate tuft	do	Short single.
Aëdes (*Stegomyia*) *variegatus* Schrank	do	Fairly long single	do	Short.
Rachionotomyia caledonica Edwards	do	Long fan	do	Very short.
Rachionotomyia sp?	do	do	do	Do.
Uranotænia quadrimaculata Paine and Edwards	Short double	Long single	Short single	Do.

MESOTHORACIC GROUP OF PLEURAL HAIRS.

Tribe, genus, and species.	II-av.	II-ad.	II-pv.	II-pd.
AMERICAN SPECIES				
Tribe Anophelini				
Genus *Chagasia* Cruz (after Root)	Long single	Long single	Short	Very short.
Genus *Anopheles* Meigen (after Puri and Root)	do	do	do	Do.
Tribe Megarhinini				
Genus *Megarhinus* Robineau-Desvoidy:				
M. septentrionalis Dyar and Knab	do	Long stout spinose	Long single	Do.
M. portoricensis von Röder	do	do	do	Do.
M. trinidadensis Dyar and Knab	do	do	do	Do.
M. neglectus Lutz	do	do	do	Do.
M. purpureus Theobald	do	do	do	Do.

Tribe Culicini				
Culicine group				
Genus *Culex* Linnæus:				
Subgenus *Neoculex* Dyar—				
C. apicalis Adams	do	Long fan	do	Do.
Subgenus *Culex* Linnæus—				
C. bahamensis Dyar and Knab	do	do	do	Do.
C. duplicator Dyar and Knab	do	do	do	Do.
C. nigripalpus Theobald	do	do	do	Do.
C. chidesteri Dyar	do	do	do	Do.
C. secutor Theobald	do	do	do	Do.
C. mollis Dyar and Knab	do	do	do	Do.
C. salinarius Coquillett	do	do	do	Do.
C. declarator Dyar and Knab	do	do	do	Do.
C. fatigans Wiedemann	do	do	do	Do.
C. pipiens Linnæus	do	do	do	Do.
C. territans Theobald	do	do	do	Do.
C. extricator Dyar and Knab	do	do	do	Do.
C. coronator Dyar	do	do	do	Do.
C. corniger Theobald	do	do	do	Do.
Subgenus *Carrollella* Lutz—				
C. bihaicolus Dyar and Nuñez Tovar	do	do	do	Do.
C. irridescens (Lutz)	do	do	do	Do.
Subgenus *Melanoconion* Theobald—				
C. atratus Theobald	do	do	do	Do.
C. aikenii (Aiken)	do	do	do	Do.
C. conservator Dyar and Knab	do	do	do	Do.
C. antillum-magnorum Dyar	do	do	do	Do.
Subgenus *Microculex* Theobald—				
C. pleuristriatus Theobald	do	do	do	Do.
C. chryselatus Dyar and Knab	do	do	do	Do.
C. imitator Theobald	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

MESOTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	II–av.	II–ad.	II–pv.	II–pd.
Genus *Culex* Linnæus—Continued.				
Subgenus *Chæroporpa* Dyar—				
C. inhibitator Dyar and Knab	Long single	Long fan	Long single	Very short.
C. educator Dyar and Knab	do	do	do	Do.
C. innominatus Evans	do	do	do	Do.
C. iolambdis Dyar	do	do	do	Do.
C. elevator Dyar and Knab	do	do	do	Do.
C. phlogistus Dyar	do	do	do	Do.
C. bastagarius Dyar and Knab	do	do	do	Do.
Subgenus *Mochlostyrax* Dyar and Knab—				
C. innovator Evans	do	do	do	Do.
C. hesitator Dyar and Knab	do	do	do	Do.
C. unicornis Root	do	do	do	Do.
C. pilosus Dyar and Knab	do	do	do	Do.
Genus *Deinocerites* Theobald:				
D. cancer Theobald	do	do	do	Do.
Intermediate group				
Genus *Aëdomyia* Theobald:				
A. squamipennis (Lynch Arribálzaga)	do	Long single	Fairly long single	Do.
Genus *Mansonia* Blanchard:				
M. humeralis Dyar and Knab	do	Long 3- to 6-branched	Long single	Do.
M. titillans (Walker)	do	do	do	Do.
M. indubitans Dyar and Shannon	do	do	do	Do.
Genus *Orthopodomyia* Theobald:				
O. signifera (Coquillett)	do	Long fan	do	Do.
O. albicosta (Lutz)	do	do	do	Do.
O. fascipes (Coquillett)	do	do	do	Do.
Genus *Theobaldia* Neveu-Lemaire:				
T. inornata (Williston)	do	do	do	Do.
T. dyari (Coquillett)	do	do	do	Do.
T. melanura (Coquillett)	do	do	do	Do.

Aëdine group				
Genus *Aëdes* Meigen:				
Subgenus *Howardina* Theobald—				
A. ioliota Dyar and Knab	do	do	do	Do
A. busckii (Coquillett)	do	do	do	Do.
A. fulvithorax (Lutz)	do	do	do	Do.
Subgenus *Finlaya* Theobald—				
A. terrens (Walker)	do	do	do	Do.
A. podographicus	do	do	do	Do.
A. triseriatus (Say)	do	do	do	Do.
A. atropalpus (Coquillett)	do	do	do	Do.
A. fluviatilis (Lutz)	do	do	do	Do.
A. mediovittatus (Coquillett)	do	do	do	Do.
Subgenus *Ochlerotatus* Lynch Arribálzaga—				
A. tæniorhynchus (Wiedemann)	do	do	do	Do.
A. sollicitans (Walker)	do	do	do	Do.
A. mitchellæ (Dyar)	do	do	do	Do.
A. canadensis (Theobald)	do	do	do	Do.
A. punctor (Kirby)	do	do	do	Do.
A. cantator (Coquillett)	do	do	do	Do.
A. fulvus (Wiedemann)	do	do	do	Do.
A. atlanticus Dyar and Knab	do	do	do	Do.
A. tormentor Dyar and Knab	do	do	do	Do.
A. scapularis (Rondani)	do	do	do	Do.
A. infirmatus Dyar and Knab	do	do	do	Do.
A. angustivittatus Dyar and Knab	do	do	do	Do.
A. nubilus (Theobald)	do	do	do	Do.
A. serratus (Theobald)	do	do	do	Do.
A. tortilis (Theobald)	do	do	do	Do.
A. dupreei (Coquillett)	do	do	do	Do.
A. hastatus Dyar	do	do	do	Do.
Subgenus *Stegomyia* Theobald—				
A. ægypti (Linnæus)	do	Long double	do	Do.
Subgenus *Aëdimorphus* Theobald—				
A. vexans (Meigen)	do	Long fan	do	Do.
Subgenus *Aëdes* Meigen—				
A. cinereus Meigen	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

MESOTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	II–av.	II–ad.	II–pv.	II–pd.
Genus *Psorophora* Robineau-Desvoidy:				
Subgenus *Grabhamia* Theobald—				
P. cingulata (Fabricius)	Long single	Long fan	Long single	Very short.
P. columbiæ (Dye and Knab)	do	do	do	Do.
P. jamaicensis (Theobald)	do	do	do	Do.
P. confinnis (Lynch Arribálzaga)	do	do	do	Do.
P. discolor (Coquillett)	do	do	do	Do.
Subgenus *Janthinosoma* Lynch Arribálzaga—				
P. cyanescens (Coquillett)	do	do	do	Do.
P. ferox (Humboldt)	do	do	do	Do.
P. lutzii Theobald	do	do	do	Do.
Subgenus *Psorophora* Robineau-Desvoidy—				
P. lineata (Humboldt)	Short split	Long single	Short split	Do.
P. cilipes (Fabricius)	Fairly long double	do	Fairly long single	Do.
P. howardii Coquillett	do	do	do	Do.
P. ciliata (Fabricius)	Short split	do	Short split	Do.
Genus *Hæmagogus* Williston:				
H. splendens Williston	Long single	Long fan	Long single	Do.
Sabethine group				
Genus *Joblotia* Blanchard:				
J. compressa (Theobald)	do	Long 2- to 4-branched	do	Short.
J. digitata (Rondani)	do	do	do	Do.
Genus *Goeldia* Theobald:				
G. lunata (Theobald)	do	Long fan	do	Spine.
G. longipes (Fabricius)	do	do	do	Do.
Genus *Isostomyia* Coquillett:				
I. magna (Theobald)	do	do	do	Do.

Genus *Wyeomyia* Theobald:				
Subgenus *Wyeomyia* Theobald—				
W. longirostris Theobald	do	Long double	do	Very short.
W. quasiluteoventralis (Theobald)	do	Long single	do	Do.
W. pertinans (Williston)	do	do	do	Do.
W. gaudians Dyar and Nuñez Tovar	do	do	do	Do.
Subgenus *Phyllozomyia* Dyar—				
W. smithii (Coquillett)	do	Long double	do	Do.
W. celænocephala Dyar and Knab	do	do	do	Do.
Subgenus *Pentemyia* Dyar—				
W. bromeliarum Dyar and Knab	do	do	do	Do.
Subgenus *Nunezia* Dyar—				
W. bicornis (Root)	Fairly long single	Long 4-branched fan	do	Do.
Subgenus *Dodecamyia* Dyar—				
W. quasilongirostris (Theobald)	Long single	Long single	do	Do.
W. pilicauda Root	do	do	do	Do.
Subgenus *Dinomyia* Dyar—				
W. mystes (Dyar)	do	Long double	do	Spine.
W. bourrouli Peryassú	do	Long triple	do	Do.
Subgenus *Melanolepis* Dyar—				
W. comrlosa Dyar	do	Long 4-branched	do	Do.
Subgenus *Heliconiamyia* Dyar—				
W. chalcocephala (Dyar and Knab)	do	Long triple	do	Very short.
Subgenus *Calladimyia* Dyar—				
W. melanoides Root	do	Long double	do	Do.
Subgenus *Decamyia* Dyar—				
W. pseudopecten (Dyar and Knab)	do	do	do	Do.
W. felicia Dyar and Nuñez Tovar	do	do	do	Do.
Genus *Limatus* Theobald:				
L. durhamii Theobald	do	Long 3 or 4-branched	do	Do.
L. asulleptus (Theobald)	do	do	do	Do.
Genus *Sabethoides* Theobald:				
S. purpureus Theobald	do	Long fan	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

MESOTHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	II-av.	II-ad.	II-pv.	II-pd.
Uranotænia group				
Genus *Uranotænia* Lynch Arribálzaga:				
U. sapphirina (Osten-Sacken)	Long single	Long fan	Fairly long single	Very short.
U. pulcherrima Lynch Arribálzaga	do	do	do	Do.
U. geometrica Theobald	do	do	do	Do.
U. lowii Theobald	do	do	do	Do.
U. coatzacoalcos Dyar and Knab	do	do	do	Do.
OLD-WORLD SPECIES				
Lutzia tigripes Grandpré and Charmoy	do	do	do	Do.
Culex (*Culex*) *sitiens* Wiedemann	do	do	do	Do.
Culex (*Culex*) *pacificus* Edwards	do	do	do	Do.
Culex (*Lophoceratomyia*) sp?	do	do	do	Do.
Aëdes (*Finlaya*) *albilabris* Edwards	do	do	do	Do.
Aëdes (*Stegomyia*) *albolineatus* Theobald	do	do	do	Do.
Aëdes (*Stegomyia*) *variegatus* Schrank	do	do	do	Do.
Pachionotomyia caledonica Edwards	do	do	do	Do.
Rachionotomyia sp?				
Uranotænia quadrimaculata Paine and Edwards	do	Long single	Short single	Do.

METATHORACIC GROUP OF PLEURAL HAIRS.

Tribe, genus, and species.	III-av.	III-ad.	III-pv.	III-pd.
AMERICAN SPECIES				
Tribe Anophelini				
Genus *Chagasia* Cruz (after Root)	Long single	Long single	Long single	Very short.
Genus *Anopheles* Meigen (after Puri and Root)	Long single or feathered	Long single or feathered	Short	Do.

Tribe Megarhinini				
Genus ***Megarhinus*** Robineau-Desvoidy:				
M. septentrionalis Dyar and Knab	Long single	Long stout spinose	Fairly long single	Do.
M. portoricensis von Röder	do	do	do	Do.
M. trinidadensis Dyar and Knab	do	do	do	Do.
M. neglectus Lutz	do	do	do	Do.
M. purpureus Theobald	do	do	do	Do.
Tribe Culicini				
Culicine group				
Genus *Culex* Linnæus:				
Subgenus *Neoculex* Dyar—				
C. apicalis Adams	do	Long fan	Short single	Do.
Subgenus *Culex* Linnæus—				
C. bahamensis Dyar and Knab	do	do	do	Do.
C. duplicator Dyar and Knab	do	do	do	Do.
C. nigripalpus Theobald	do	do	do	Do.
C. chidesteri Dyar	do	do	do	Do.
C. secutor Theobald	do	do	do	Do.
C. mollis Dyar and Knab	do	do	do	Do.
C. salinarius Coquillett	do	do	do	Do.
C. declarator Dyar and Knab	do	do	do	Do.
C. fatigans Wiedemann	do	do	do	Do.
C. pipiens Linnæus	do	so	do	Do.
C. territans Theobald	do	do	do	Do.
C. extricator Dyar and Knab	do	do	do	Do.
C. coronator Dyar	do	do	do	Do.
C. corniger Theobald	do	do	do	Do.
Subgenus *Carrollella* Lutz—				
C. bihaicolus Dyar and Nuñez Tovar	do	do	do	Do.
C. iridescens (Lutz)	do	do	do	Do.
Subgenus *Melanoconion* Theobald—				
C. atratus Theobald	do	do	do	Do.
C. aikenii (Aiken)	do	do	do	Do.
C. conservator Dyar and Knab	do	do	do	Do.
C. antillum-magnorum Dyar	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	III-av.	III-ad.	III-pv.	III-pd.
Tribe Culicini—Continued				
Culicini group—Continued				
Genus *Culex* Linnæus—Continued.				
Subgenus *Microculex* Theobald—				
C. pleuristriatus Theobald	Long single	Long fan	Short single	Very short.
C. chryselatus Dyar and Knab	do	do	do	Do.
C. imitator Theobald	do	do	do	Do.
Subgenus *Chæroporpa* Dyar—				
C. inhibitator Dyar and Knab	do	do	do	Do.
C. educator Dyar and Knab	do	do	do	Do.
C. innominatus Evans	do	do	do	Do.
C. iolambdis Dyar	do	do	do	Do.
C. phlogistus Dyar	do	do	do	Do.
C. bastagarius Dyar and Knab	do	do	do	Do.
Subgenus *Mochlostyrax* Dyar and Knab—				
C. innovator Evans	do	do	One-half long single	Do.
C. hesitator Dyar and Knab	do	do	do	Do.
C. unicornis Root	do	do	do	Do.
C. pilosus Dyar and Knab	do	do	do	Do.
Genus *Deinocerites* Theobald:				
D. cancer Theobald	do	do	Short single	Do.
Intermediate group				
Genus *Aëdeomyia* Theobald:				
A. squamipennis (Lynch Arribálzaga)	do	Long single	do	Do.
Genus *Mansonia* Blanchard:				
M. humeralis Dyar and Knab	do	Long triple	do	Do.
M. titillans (Walker)	do	do	do	Do.
M. indubitans Dyar and Shannon	do	do	do	Do.

Genus *Orthopodomyia* Theobald:				
O. signifera (Coquillett)	do	Long fan	do	Do.
O. albicosta (Lutz)	do	do	do	Do.
O. fascipes (Coquillett)	do	do	do	Do.
Genus *Theobaldia* Neveu-Lemaire:				
T. inornata (Williston)	do	do	Short double	Do.
T. dyari (Coquillett)	do	do	Short single	Do.
T. melanura (Coquillett)	do	do	Short double	Do.
Aëdine group				
Genus *Aëdes* Meigen:				
Subgenus *Howardina* Theobald—				
A. ioliota Dyar and Knab	do	do	Short single	Do.
A. busckii (Coquillett)	do	do	do	Do.
A. fulvithorax (Lutz)	do	do	do	Do.
Subgenus *Finlaya* Theobald—				
A. terrens (Walker)	do	do	do	Do.
A. podographicus Dyar and Knab	do	do	do	Do.
A. triseriatus (Say)	do	do	do	Do.
A. atropalpus (Coquillett)	do	do	do	Do.
A. fluviatilis (Lutz)	do	do	do	Do.
A. mediovittatus (Coquillett)	do	do	do	Do.
Subgenus *Ochlerotatus* Lynch Arribálzaga—				
A. tæniorhynchus (Wiedemann)	do	do	do	Do.
A. sollicitans (Walker)	do	do	do	Do.
A. mitchellæ (Dyar)	do	do	do	Do.
A. canadensis (Theobald)	do	do	do	Do.
A. punctor (Kirby)	do	do	do	Do.
A. cantator (Coquillett)	do	do	do	Do.
A. fulvus (Wiedemann)	do	do	do	Do.
A. atlanticus Dyar and Knab	do	do	do	Do.
A. tormentor Dyar and Knab	do	do	do	Do.
A. scapularis (Rondani)	do	do	do	Do.
A. infirmatus Dyar and Knab	do	do	do	Do.
A. angustivittatus Dyar and Knab	do	do	do	Do.
A. nubilus (Theobald)	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	III-av.	III-ad.	III-pv.	III-pd.
Aëdine group—Continued				
Genus *Aëdes* Meigen—Continued.				
Subgenus *Ochlerotatus* Lynch Arribálzaga—Ctd.				
A. serratus (Theobald)	Long single	Long fan	Short single	Very short.
A. tortilis (Theobald)	do	do	do	Do.
A. dupreei (Coquillett)	do	do	do	Do.
A. hastatus Dyar	do	Long double	do	Do.
Subgenus *Stegomyia* Theobald—				
A. ægypti (Linnæus)	do	do	do	Do.
Subgenus *Aëdimorphus* Theobald—				
A. vexans (Meigen)	do	Long fan	do	Do.
Subgenus *Aëdes* Meigen—				
A. cinereus Meigen	do	do	do	Do.
Genus *Psorophora* Robineau-Desvoidy:				
Subgenus *Grabhamia* Theobald—				
P. cingulata (Fabricius)	do	do	Fairly long single	Do.
P. columbiæ (Dyar and Knab)	do	do	do	Do.
P. jamaicensis (Theobald)	do	do	do	Do.
P. confinnis (Lynch Arribálzaga)	do	do	do	Do.
P. discolor (Coquillett)	do	do	do	Do.
Subgenus *Janthinosoma* Lynch Arribázaga—				
P. cyanescens (Coquillett)	do	do	Long single	Do.
P. ferox (Humboldt)	do	do	do	Do.
F. lutzii Theobald	do	do	do	Do.
Subgenus *Psorophora* Robineau-Desvoidy—				
P. lineata (Humboldt)	One-half long single	Long single	Short split into 2 or 3	Do.
P. cilipes (Fabricius)	do	do	do	Do.
P. howardii Coquillett	One-half long split into 2 or 3	do	Short split into 3 or 4	Do.
P. ciliata (Fabricius)	do	do	do	Do.
Genus *Hæmagogus* Williston:				
H. splendens Williston	Long single	Long fan	Short single	Do.

Sabethine group				
Genus *Joblotia* Blanchard:				
J. compressa (Theobald)	do	Long 2- to 5-branched	Long single	Do.
J. digitata (Rondani)	do	do	do	Spine.
Genus *Goeldia* Theobald:				
G. lunata (Theobald)	do	Long fan	Short single	Do.
Genus *Isostomyia* Coquillett:				
I. magna (Theobald)	do	do	do	Do.
Genus *Wyeomyia* Theobald:				
Subgenus *Wyeomyia* Theobald—				
W. longirostris Theobald	do	Long double or triple	do	Very short.
W. quasiluteoventralis (Theobald)	do	do	do	Do.
W. pertinans (Williston)	do	do	do	Do.
W. gaudians Dyar and Nuñez Tovar	do	do	do	Do.
Subgenus *Phyllozomyia* Dyar—				
W. smithii (Coquillett)	Long double or triple	do	do	Do.
W. celænocephala Dyar and Knab	Long single	do	do	Do.
Subgenus *Pentemyia* Dyar—				
W. bromeliarum Dyar and Knab	do	Long fan 4- or 5-branched	Long single	Do.
Subgenus *Nunezia* Dyar—				
W. bicornis (Root)	do	Long fan	Short single	Do.
Subgenus *Dodecamyia* Dyar—				
W. quasilongirostris (Theobald)	do	do	do	Do.
W. pilicauda Root	do	do	do	Do.
Subgenus *Dinomyia* Dyar—				
W. mystes (Dyar)	do	Long triple	do	Do.
W. bourrouli Peryassú	do	Long fan	do	Spine.
Subgenus *Melanolepis* Dyar—				
W. complosa Dyar	do	do	do	Do.
Subgenus *Heliconiamya* Dyar—				
W. chalcocephala (Dyar and Knab)	do	do	do	Do.
Subgenus *Calladimyia* Dyar—				
W. melanoides Root	do	do	do	Spine (branched).
Subgenus *Decamyia* Dyar—				
W. pseudopecten (Dyar and Knab)	do	do	do	Large spine.
W. felicia Dyar and Nuñez Tovar	do	do	do	Do.

TABLE 2.—*Comparative lengths and types of branching of the pleural hairs of the mosquito larvæ examined*—Continued.

METATHORACIC GROUP OF PLEURAL HAIRS—Continued.

Tribe, genus, and species.	III-av.	III-ad.	III-pv.	III-pd.
Sabethine group—Continued				
Genus *Limatus* Theobald:				
L. durhamii Theobald	Long single	Long 4-branched	Short single	Very short.
L. asulleptus (Theobald)	do	Long 3- or 4-branched	do	Do
Genus *Sabethoides* Theobald:				
S. purpureus Theobald	do	Long fan	do	Do.
Uranotænia group				
Genus *Uranotænia* Lynch Arribálzaga:				
U. sapphirina (Osten-Sacken)	do	do	do	Do.
U. pulcherrima Lynch Arribálzaga	do	do	do	Do.
U. geometrica Theobald	do	do	do	Do.
U. coatzacoalcos Dyar and Knab	do	do	do	Do.
OLD-WORLD SPECIES				
Lutzia tigripes Grandpré and Charmoy	do	do	do	Do.
Culex (*Culex*) *sitiens* Wiedemann	do	do	Short double	Do.
Culex (*Culex*) *pacificus* Edwards	do	do	Short single	Do.
Culex (*Lophoceratomyia*) sp?	do	do	Short triple	Do.
Aëdes (*Finlaya*) *albilabris* Edwards	do	do	Short single	Do.
Aëdes (*Stegomyia*) *albolineatus* Theobald	do	do	do	Do.
Aëdes (*Stegomyia*) *variegatus* Schrank	do	do	do	Do.
Rachionotomyia caledonica Edwards	do	do	do	Do.
Rachionotomyia sp?	do	do	do	Do.
Uranotænia quadrimaculata Paine and Edwards	do	Long single	do	Do.

in the mesothoracic group; another leading through *Joblotia* and *Wyeomyia* (*Dodecamyia*) to the sabethines, characterized by the tendency towards the branching of more than one of the long hairs of the prothoracic group; and the third leading through *Aëdeomyia* to the normal series of culicines (such as *Aëdes*, *Culex*, etc.) and perhaps also to *Uranotænia*.

From the foregoing discussion and from the data previously tabulated regarding the characteristics of the pleural hairs of the various culicine genera it may be clearly seen that, in some cases at least, the variations in the groups of pleural hairs appear to afford some evidence as to the evolutionary position of the different genera. On the other hand, it must also be plainly understood that, in other cases, modifications of the pleural hairs seem to be correlated with the adaptation of the larvæ to unusual types of breeding places.

This may be seen clearly in the genus *Aëdes*, where the normal series of forms, which breed in temporary pools (especially the subgenera *Ochlerotatus* and *Aëdimorphus*) have hair I–ad fairly long and single. The same condition appears in the two species of the subgenus *Finlaya* (*atropalpus* and *fluviatilis*) which breed in rock pools, but in the tree-hole-breeding species of *Finlaya* and in *Howardina* and *Hæmagogus*, which also breed in water held by plants, as a rule, this hair is branched and usually short, sometimes forming a stellate tuft.

In the genus *Culex*, on the other hand, the normal series of forms that breed in permanent pools (subgenera *Culex* and *Chœroporpa* and some species of *Melanoconion*) have both I–ad and I–av short and single, whereas the forms that breed in water held by plants (subgenera *Carrollella* and *Microculex* and some species of *Melanoconion*) have I–ad fairly long. This is also the case in *Culex* (*Culex*) *corniger*, which does not breed in water held by plants but does occupy an unusual breeding place for its subgenus; namely, temporary pools. However, in the subgenus *Mochlostyrax* (also breeding in temporary pools, as a rule) the prothoracic group is of the same type as in the normal series, but hair III–pv of the metathoracic group is unusually long.

The peculiarities of the prothoracic group of pleural hairs in *Orthopodomyia* (I–ad is a long fan) and in the sabethines (I–av and I–ad both usually long and branched from the base) may also be correlated with the fact that these, too, are forms which breed only in water held by various kinds of plants instead of in collections of water on the ground.

SUMMARY

1. The pleural hairs of the larvæ of over one hundred species of American culicine mosquitoes have been examined and a certain number of the Old World species are compared with the related American species; the comparative lengths and types of branching of the hairs are recorded in Table 2 and shown on the plates.

2. From this study it appears that many of the tribes and genera and some of the subgenera of the American culicine mosquitoes are characterized by fairly definite peculiarities of the pleural hairs of the larvæ.

3. Judging by the pleural hairs, *Megarhinus* represents the most primitive type of mosquito, and in the higher forms three different lines of specialization seem to be indicated, resulting in the anophelines, the sabethines, and the *Culex-Aëdes-Uranotænia* complex.

4. In certain cases modifications of the pleural hairs seem to have resulted from the adaptation of the larvæ to unusual types of breeding places. In particular, larvæ which occur normally in water held by plants appear to have the pleural hairs, especially those of the prothorax, more extensively branched than do their relatives that live in collections of water on the ground.

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ILLUSTRATIONS

[I, Prothoracic group; II, mesothoracic group; III, metathoracic group; *a*, anterior dorsal; *b*, anterior ventral; *c*, posterior ventral; *d*, posterior dorsal.]

PLATE 1

FIG. 1. *Megarhinus trinidadensis* Dyar and Knab.
2. *Culex* (*Mochlostyrax*) *pilosus* Dyar and Knab.
3. *Culex* (*Culex*) *fatigans* Wiedemann.
4. *Deinocerites cancer* Theobald.
5. *Aëdeomyia squamipennis* (Lynch Arribálzaga).
6. *Mansonia titillans* Walker.
7. *Orthopodomyia signifera* (Coquillett).

PLATE 2

FIG. 8. *Theobaldia inornata* Freeborn.
9. *Theobaldia melanura* Coquillett.
10. *Aëdes* (*Howardina*) *buskii* (Coquillett).
11. *Aëdes* (*Finlaya*) *podographicus* Dyar and Knab.
12. *Aëdes* (*Ochlerotatus*) *scapularis* (Rondani).
13. *Aëdes* (*Stegomyia*) *ægypti* (Linnæus).
14. *Aëdes* (*Aedimorphus*) *vexans* (Meigen).

PLATE 3

FIG. 15. *Psorophora* (*Grabhamia*) *cingulata* (Fabricius).
16. *Psorophora* (*Janthinosoma*) *ferox* (Humboldt).
17. *Psorophora* (*Psorophora*) *ciliata* (Fabricius).
18. *Lutzia tigripes* Grandpré and Charmoy.
19. *Joblotia digitata* (Rondani).
20. *Goeldia lunata* (Theobald).

PLATE 4

FIG. 21. *Wyeomyia quasiluteoventralis* (Theobald).
22. *Wyeomyia quasilongirostris* Theobald.
23. *Dendromyia complosa* Dyar.
24. *Limatus durhamii* Theobald.
25. *Dendromyia melanoides* Root.
26. *Uranotænia geometrica* Theobald.

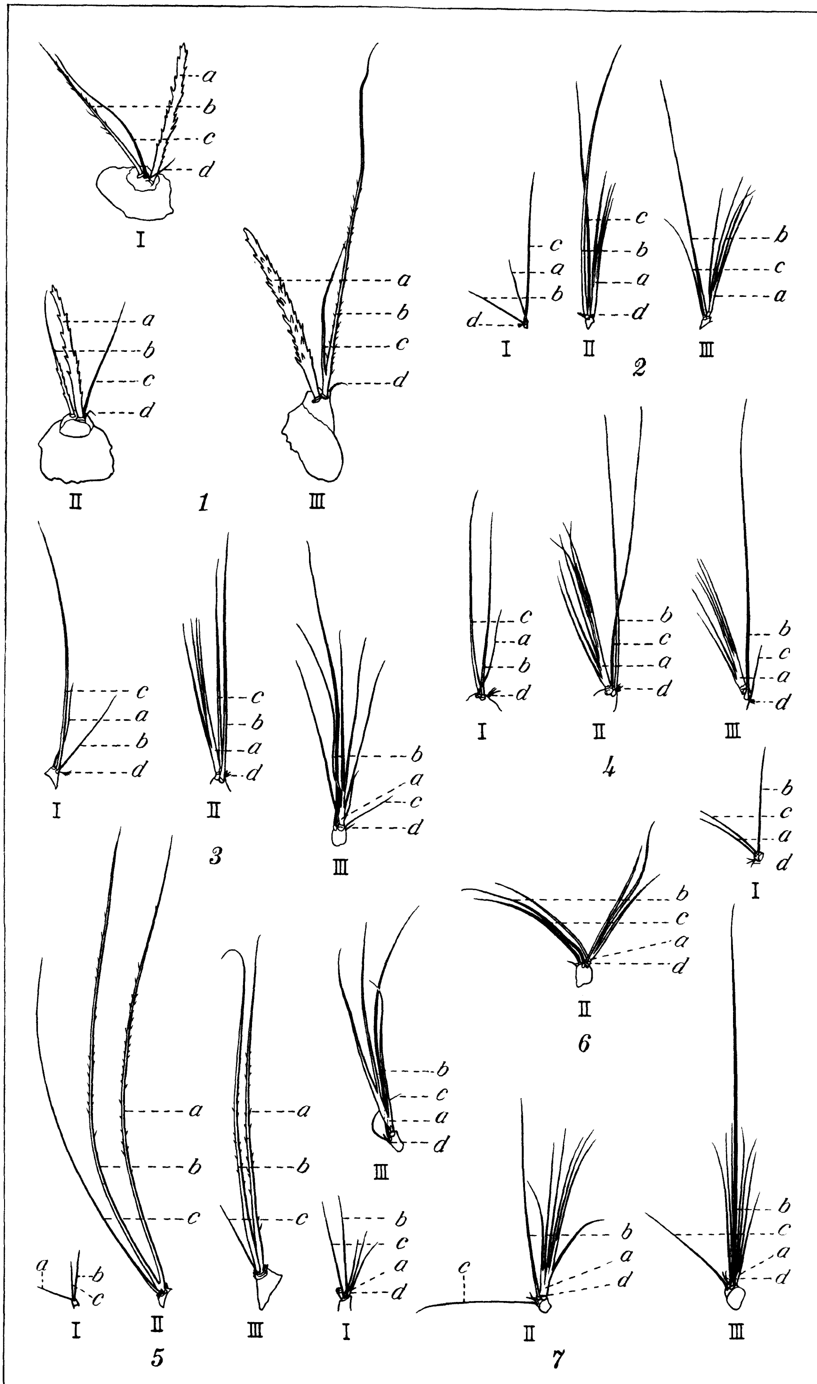

PLATE 1.

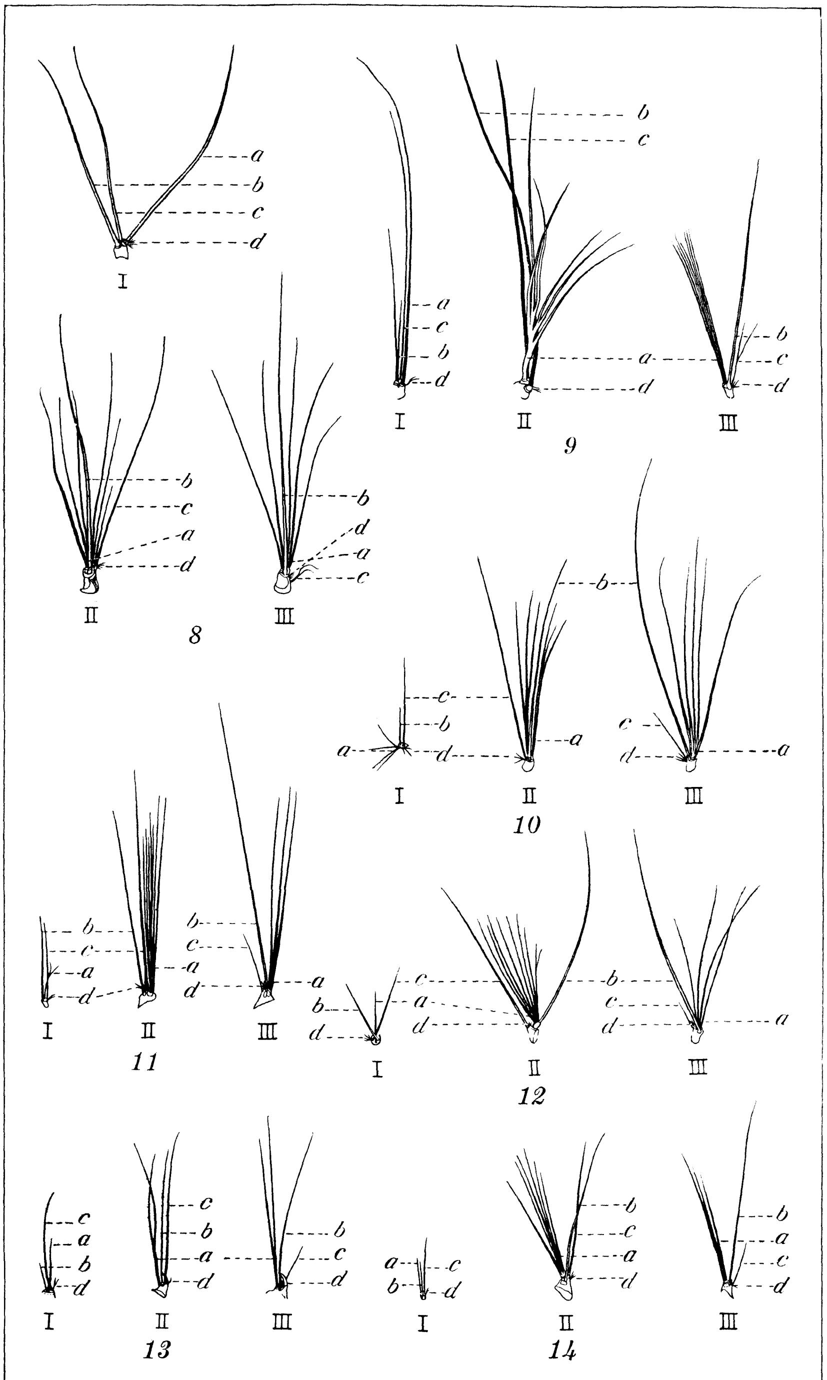

PLATE 2.

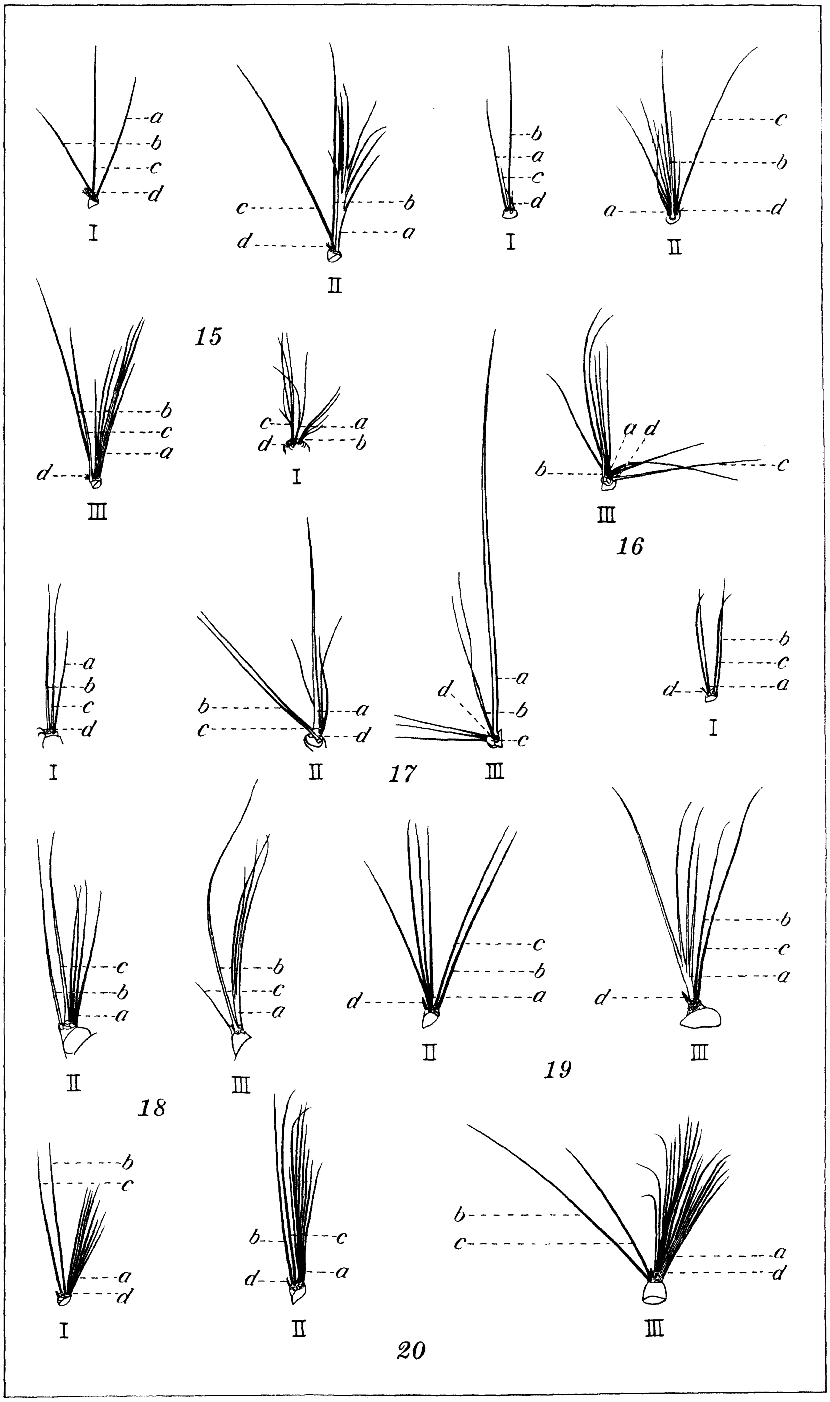

PLATE 3.

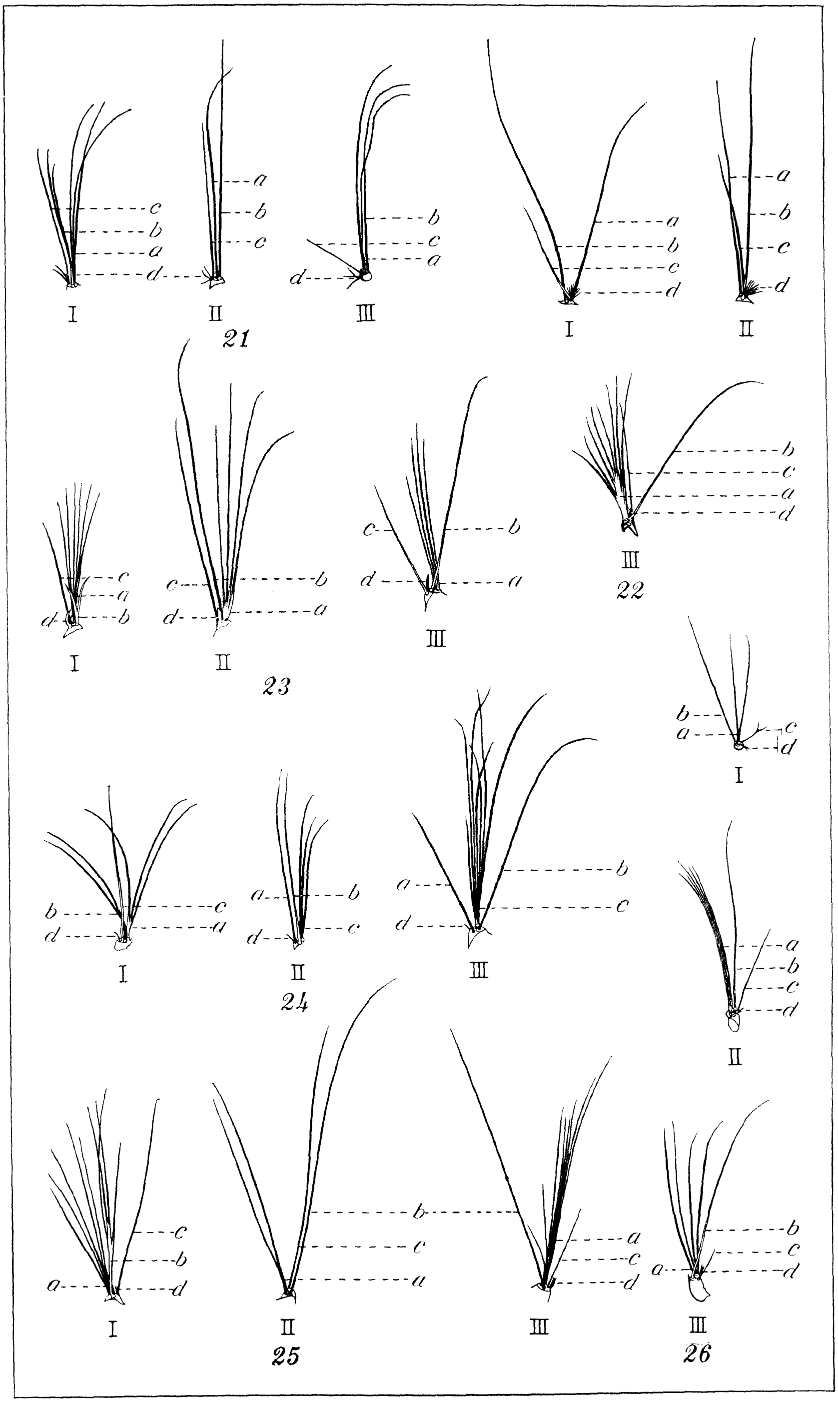

PLATE 4.

CHIRONOMIDÆ FROM JAPAN (DIPTERA), VIII

MARINE OR SEASHORE SPANIOTOMA, WITH DESCRIPTIONS OF THE IMMATURE FORMS OF SPANIOTOMA NEMALIONE SP. NOV. AND TANYTARSUS BOODLEÆ TOKUNAGA.[1]

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TWO PLATES AND ONE TEXT FIGURE

The chironomid flies discussed here are from the Pacific coast of Kii Peninsula. Larval stages of some species still remain to be found, but I was convinced from the habits of the adults that they must breed in the sea or at least they must be of the haloxenic type.

I am greatly indebted to Prof. Dr. Hachiro Yuasa for his kind direction for the survey of the marine insect fauna. My deepest thanks are also extended to Prof. Dr. Yô K. Okada, director of the Seto Marine Biological Station, of Kyoto Imperial University, for the use of various equipments.

SPANIOTOMA (SMITTIA) LITTORALIS sp. nov.

This minute midge was swarming on the gravelly seashore in great numbers in the evening. Swarming takes place very low, about 100 mm from the surface of the ground, and usually above the zone of the high-tide mark. The immature insects have not been found; probably they hide under the shore drift.

Male.—Body minute, about 1.2 mm long, dull black in general appearance; mouth parts, antennæ, legs, and abdomen brownish black; halteres yellowish white.

Head scantily haired, with only four setæ on vertex behind each eye; frontoclypeus with only six or seven setæ; eyes bare, small, reniform, widely separated from each other on the vertex, distance between them far greater than the vertical length of the eyes (13 : 9) and about 0.6 of the head width. Maxillary palpus 4-segmented (6 : 15 : 17 : 28). Antenna 14-segmented but rarely distal two segments fused, with black plumose hairs;

[1] Contribution from the entomological laboratory of Kyoto Imperial University, No. 52. Contribution from the Seto Marine Biological Laboratory of Kyoto Imperial University.

antennal ratio 0.6 (0.5–0.8); ultimate flagellar segment with short setæ on its distal one-third and a long apical seta, without preapical bare area.

Thorax brown in ground color; pronotum very narrow at dorsomeson, not visible from above, each lateral half with two minute setæ on ventral margin; scutum with three black vittæ; dorsal setæ distinct, suberect, arising from yellow punctures arranged in a double row on the cephalic half and in a single row on the caudal half along the entire length of each pseudosutural fovea; supra-alar setal group represented by six or seven setæ; scutellum dark brown, with six setæ.

Wings (Plate 1, fig. 1) about 1 mm long including squama, milky white by reflected light and hyaline by transmitted light, macrotrichia wanting; squama small, without setæ; anal angle obtuse; marginal setal row of the wing interrupted at the end of vein R_{4+5}. Veins without macrotrichia; costa not produced beyond R_{4+5}; R_{2+3} present, extending close along R_{4+5}, but ending on costa separately from R_{4+5}; R_{4+5} slightly curved cephalad as in the other branches of the radius, ending much before the level of the tip of M_{3+4}; M_{1+2} almost straight; r-m slightly oblique, very short; fCu much beyond the crossvein; M_{3+4} slightly curved downward, atrophied just before the margin; Cu_1 bent downward, very slightly wavy, not reaching the margin; Cu_2 straight, beyond fCu; 1st A straight, short, atrophied far before fCu.

Legs highly setigerous throughout the entire length, the setæ very long especially on femora, tibiæ, and basitarsi of all legs; tibial spurs finely pubescent at base; fore and middle tibiæ each with only one strong spur, without combs; hind tibia with two spurs and a comb which consists of twelve to fourteen free spinules; proximal four tarsal segments each provided with two, short, apical bristles; pulvilli absent; empodium larger than the claws. Relative lengths of the segments of legs, excepting the two proximal segments, as follows: In the foreleg 19.5 : 19.5 : 13.5 : 7 : 4.5 : 3 : 3, in the middle leg 20 : 20 : 11 : 6 : 4.5 : 3 : 3, and in the hind leg 22 : 22 : 14 : 7 : 7 : 3 : 3.

Abdomen scantily haired, with only six or seven pairs of setæ on each tergum, with a black band on the posterior margin of the tergum. Hypopygium (Plate 1, fig. 5) with a pubescent triangular anal point; coxite with a chitinized pubescent lobe on its distomesal end, rarely with another swollen lobe on its distoventral side; ventral thickened ridge of the coxite with six slender setæ; style strongly chitinized, slender, scantily haired, with a small apical bristle.

Female.—Body yellowish brown. Wings broader than in the male; anal angle very obtuse; costa slightly beyond the end of R_{4+5}; dorsal vittæ of the scutum reddish brown, distinctly separated. Antennæ 6-segmented (10 : 17 : 14 : 14 : 12 : 25), each with a small apical seta. Abdomen with brown bands on dorsum; ninth segment with a pair of setigerous, rodlike projections on its lateral side. Other structures as in the male.

Habitat.—Gravelly seashore; Japan.

Holotype.—Male; Seto, Wakayama Prefecture; July 5, 1930.

Allotype.—Female; Ukijima, Mie Prefecture; August 6, 1934.

Paratypes.—Males; Seto, Wakayama Prefecture; July 5, 1930, and Ukijima, Mie Prefecture; August 6, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory, Kyoto Imperial University; collected by M. Tokunaga.

According to the taxonomic system of Edwards[2] this species belongs to group E of the subgenus *Smittia;* the general structures closely resemble those of *S.* (*S.*) *curticosta* Edwards and *S.* (*S.*) *trilobata* Edwards, but they are well separated from each other in the structures of the hypopygium. The structures of the wing and the hypopygium are very closely similar to those of *S.* (*S.*) *brevifurcata* Edwards, but the species differ in the color of the halteres, the value of the antennal ratio, and the shape of the styles.

SPANIOTOMA (SMITTIA) NEMALIONE sp. nov.

This small dark midge was colonizing on the algal matting of *Nemalion pulvinatum* and *Endocladia complanata* on the tidal zone of the rocky shore associating with *Clunio tsushimensis* (Tokunaga, 1935, Mushi 8).

Male.—Body about 1.6 mm long, ground color black; antennæ, mouth parts, and scutellum brown; legs and halteres yellowish brown.

Head with about ten setæ on the vertex; eyes reniform, finely pubescent, widely separated from each other, distance between them subequal to the vertical length of the eye (11 : 10) and ratio to head width about 11 : 18; frontoclypeus with only three or four black setæ. Maxillary palpus 4-segmented (10 : 18 : 19 : 33). Antenna 9-segmented; plumose hairs highly reduced, three to five setæ being found on each intermediate flagellal segment; ultimate segment elongated, spindle-shaped, subequal in length

[2] Trans. Ent. Soc. London (1929).

to the preceding three segments taken together, with about three short setæ on the proximal region, without apical bristles; antennal ratio about 0.4 (34 : 83).

Wings (Plate 1, fig. 2) milky white by reflected light and brown by transmitted light, without macrotrichia on the membrane; costal cells, C, Sc, and R_1 fuscous; squama without setæ; anal lobe obtuse. Veins R, R_1, R_{4+5} with macrotrichia; costa produced beyond the end of R_{4+5}, extending more distad beyond the level of the end of M_{3+4}; R_{4+5} long, somewhat swollen, almost straight, closely extending along R_1 and C, ending on costa with a very sharp angle at the opposite side of the end of M_{3+4}; R_{2+3} seemingly absent due to its close contact with R_{4+5} throughout its whole length, as in *Eukiefferiella;* M_{1+2}, M_{3+4}, and Cu_1 atrophied just before wing margin; M_{1+2} almost straight; M_{3+4} almost straight and continuing the direction of the stem; Cu_1 slightly sinuous; 1st A slightly beyond fCu, very slightly curved downward, atrophied far before the wing margin.

Legs without long hairs; foreleg with a strong tibial spur, middle leg with a long and a minute tibial spur, and hind leg with two long tibial spurs accompanied by a small tibial comb which consists of about six free spinules (varying from four to ten); tarsi with small spurlike spinules on the ventral side of each segment; proportional lengths of leg segments, excepting the coxæ and trochanters, as follows: 31 : 38 : 18 : 11 : 7 : 4 : 4 in the foreleg, 39 : 40 : 18 : 9 : 7 : 4 : 4 in the middle leg, and 35 : 38 : 20 : 9 : 9 : 4 : 4 in the hind leg; pulvilli absent; empodium well developed, as long as the claws; claws spatulate and slightly serrate at tip.

Thorax scantily setigerous with about six erect setæ which arise from distinct punctures arranged along pseudosutural fovea; pronotum separated at middle, bare, but rarely with a seta on either lateroventral margin; scutellum brown, with two pairs of black setæ; two or three supra-alar setæ.

Abdomen comparatively setigerous, with short setæ. Hypopygium (Plate 1, fig. 7) with a distinct anal point, which is highly pubescent with black spinules and distinctly clavate in the lateral aspect; coxite stout, with a blunt membranous swelling on the mesal margin; style large, highly pubescent with dark spinules, scantily setigerous on the ventral side, with a small chitinized spine on its tip.

Female.—Body 1.5 to 2 mm long, color as in the male. Frontoclypeus with two pairs of setæ. Antennæ 6-segmented

(10 : 20 : 12 : 12 : 11 : 29); terminal segment with only one seta on its basal region; other intermediate segments each with two long setæ. Pronotum with a seta on either lateral margin; supra-alar setæ three. Wing comparatively broader than in the male, its anal lobe also obtuse; R_{4+5} curved along the costal margin; M_{1+2} slightly sinuous, gradually curved downward on its distal half; M_{3+4} slightly curved downward; Cu_1 strongly bent and sinuous. Relative lengths of leg segments as follows: 23 : 27 : 13 : 7 : 4.5 : 3 : 3.5 in the foreleg, 30 : 32: 14 : 7 : 5 : 3 : 4 in the middle leg, and 28 : 30 : 15 : 7 : 7 : 3 : 3.5 in the hind leg; tibial comb of the hind leg consisting of about nine spinules, which are longer than the shorter tibial spur. Claws simple, as long as the empodium; pulvilli absent. Abdomen pale brown, appearing dark due to the subcutaneous black pigmental layer; eighth sternum dark on its cephalic half, shallowly concave on its caudal margin, with paired setigerous areas on its caudal part, with paired lobes which are somewhat angulate and pubescent with minute spinules on the caudal margin; ninth sternum, which is separated into lateral small halves by a large median membrane, also black, setigerous with about seven black setæ; cerci (Plate 1, fig. 10) setigerous with long setæ, very small, also black, somewhat pointed on the caudal angle; other parts of the hypopygium pale brown; spermathecæ (Plate 1, fig. 9) two, ovoid, dark brown, but hyaline on basal part and on duct. Other structures closely related to those of the male.

Pupa.—Body 2.5 to 2.8 mm long; exuvia yellowish hyaline; head, thorax, and genital sheaths yellowish brown.

Head without hornlike projections, provided with a pair of small setæ on vertex between antennal bases and another pair on genal part.

Thorax without respiratory horns as in general for marine chironomid pupæ; prothorax with two pairs of long setæ; mesothorax with three pairs of setal groups: One pair composed of one long and two short, closely associated setæ, located on the cephalolateral corners; other pairs composed of two, small, closely associated setæ, located on meson of scutum.

Dorsum of each abdominal segment finely spinulous all over the surface leaving only two pairs of oval clear spots and provided with a spinulous creeping ridge composed of three rows of recurved spinules on caudal margin excepting first abdominal segment; dorsal side with three pairs of setæ or setal groups on each segment: One pair of single setæ on meson of cephalic

part, one pair of single or, rarely, compound setæ on meson of caudal part, and another pair of setal groups, each of which consists of two closely associated setæ on laterocaudal part; dorsal side of first abdominal segment less spinulous than in the other segment, spinules being highly atrophied on meson; on dorsal side of eighth abdominal segment setal pairs retained only on caudal part, being represented by two pairs of simple setæ. Ventral side of each abdominal segment almost smooth and hyaline, provided with a caudal spinulous area composed of many recurved spinules arranged in an oval area, except the two cephalic segments; setal arrangement of venter as follows: One pair of simple setæ on cephalic part and one pair of double setæ on caudal part. Lateral side of each segment also spinulous, provided with a long seta on cephalic part and one or two setæ on caudal part, without lateral swimming expansions. Ultimate segment without setæ; dorsal side flat, somewhat square but slightly narrowed basally, provided with two minute points on either side of the posterior corners; in male dorsal side more elongated and more spinulous than in the female; genital sheaths distinctly protruded caudad beyond the caudal margin of the tergal plate in male, while in female they are very short, not visible from above (Plate 2, figs. 12 and 13).

Larva.—Body about 4.2 mm long in full-grown stage; head dark brown; thorax and abdomen purplish black due to the subcutaneous layer of pigment; anal gills wanting.

Head with large black eyespots on the pale areas; each eyespot consists of a large, oval, dorsal pigment granule and one or two small ventral granules; front comparatively broad, with two pairs of setæ on the lateral margin of the cephalic part; each half of the vertex with two sensory pores along the stem of the epicranial suture, an isolated seta and a sensory pore along the epicranial arm, a seta and two sensory pores near the base of antenna, a sensory pore near the eyespot, two setal groups, each of which consists of two setæ, on ventrocephalic part. Clypeus thinly and uniformly chitinized, with three pairs of slender setæ on its margin; labrum membranous, with various appendages: One pair of slender and one pair of strong nonserrate bristles on the meson, two pairs of minute sensillæ laterad of these bristles, one pair of small median and one pair of large, lateral, comblike or featherlike appendages on the meson closely along the labraliæ, several (four large and two small) trichoid appendages on the lateral side. Epipharynx with one pair of small, and three pairs of strong, clawlike appendages close to each other

on the meson; four setæ on the V-shaped chitinization of epipharynx; one large and one small oval chitinization just caudad of V-shaped thickening; premandibles (Plate 2, fig. 18) each with one minute and two distinct teeth. Antenna (Plate 2, fig. 14) very small, 5-segmented, with a large sensory pore, two minute setæ and two large trichoid sensillæ on proximal segments; a clavate hyaline sensilla on second segment. Mandible comparatively slender, with five distinct teeth, a short hyaline bristle, which does not extend to tip of the most proximal tooth, and large plumose hairs (Plate 2, fig. 15) on inner side; suprabrustia wanting. Maxilla (Plate 2, fig. 16) almost hyaline; lacinia fringed with strong projections, with four sensory pegs; maxillary palpus double in structure, crowned with minute sensory appendages. Mentum (Plate 2, fig. 17) with a broad median tooth, flanked by four lateral teeth at either side, with a pair of setal tufts, each of which consists of three setæ, as in *Spaniotoma pacifica* (Saunders). Hypopharynx with a pair of serrate bristles, two or three pairs of sensory pegs, and several conical projections on the distal margin of its membranous lobe and many comblike spinules which extend inward on minute ridges on dorsal membrane of hypopharynx.

Each thoracic segment provided with two pairs of distinct setal groups on the venter; other setæ very slender and obscure; prothoracic pseudopods shallowly bilobate, studded with many thornlike claws, of which distal longer ones are finely serrate. Paired preanal setal tufts each composed of two long setæ growing directly from the integument; one pair of anal setæ on lateral side of anus; posterior pseudopods comparatively small, widely separated from each other, crowned with sixteen claws on each tip; all claws simple, nonserrate, arranged in three rows.

Habitat.—Algal matting of *Nemalion* and *Endocladia,* rocky shore of tidal zone; Japan. The food of the larvæ is largely sedentary diatoms.

Holotype.—Male; Seto, Wakayama Prefecture; April 15, 1934.

Allotopotype.—Female; April 15, 1934.

Paratypes.—Males and females; Seto, Takashiba, and Yukawa, Wakayama Prefecture; April 10 to 15, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species somewhat resembles species of the subgenus *Eukiefferiella* in the venation of the wing, especially of the male, but belongs to group B of the subgenus *Smittia* taken in con-

nection with other characters. A Canadian marine species, *Spaniotoma clavicornis* (Saunders), may be allied to the present species, but the two are easily distinguished by the characteristic structures of the male hypopygium. Another marine midge, *S. (Smittia) thalassophila* (Goetghebuer), is also related to the present fly, but the compound eyes are not pubescent and the ultimate segment of the male antenna is comparatively long.

The pupa of the present species is somewhat similar in appearance to that of the *halophilus*-group of *Trichocladius* Kieffer [3] in the absence of prothoracic respiratory horns and the spinulous dorsum of the abdomen. More intimate relation is shown among the marine species of the *Camptocladius* group of *Spaniotoma* Philippi.[4] Of the latter group *Spaniotoma pacifica* and *S. clavicornis* are the most similar to the present pupa, except in the slightly different structures of the ultimate tergum and the hyaline spots of the dorsal side.

The larva is also related to the marine forms of the *Camptocladius*-group, but may be distinguished by the number of teeth of the mandible, the setæ of the mentum, and the structure of the infrabrustia of the mandible.

SPANIOTOMA (SMITTIA) BIFURCATA sp. nov.

This is a small black midge found swarming on a gravelly tidal zone.

Male.—Body about 1.65 mm long; wing about 1.06 mm long. Thorax black; abdomen, head, antennæ, maxillary palpi, legs, and stems of halteres dark brown; knobs of halteres yellowish white.

Compound eyes bare; antennæ 14-segmented; antennal plume brown; distal segment with a small apical seta, pubescent apically, comparatively long, as long as the preceding eight segments taken together; antennal ratio about 0.7 (13 : 18).

Pronotum reduced, not visible dorsally. Wings (text fig. 1, *a*) almost hyaline by transmitted light, without macro- or microtrichia on the membrane; squama bare; anal lobe of wing obtuse; majority of veins reaching wing margin; costa not produced beyond tip of R_{4+5}; R_{4+5} ending slightly before the level of the end of M_{1+2}; R_{2+3} extending close along R_{4+5}, ending far

[3] Potthast, Arch. Hydrobiol. Supp.-Bd. (1915) 2; and Alverdes, Zeit. wiss. Ins.-Biol. (1911) 7.

[4] Saunders, Ann. Ent. Soc. Am. (1928) 21.

beyond middle between tips of R_1 and R_{4+5}; stem of Cu_1 very long, extending distad far beyond level of r-m; distal section of Cu_1 almost straight; Cu_2 forked, beyond level of r-m; Cu_{2b} straight; 1st A atrophied near base of fork of Cu_2. Legs setigerous, with brown setæ; pulvilli atrophied; empodium very slender, hardly as long as claws; claw minutely pectinate at truncate tip.

Abdomen setigerous with brown setæ; hypopygium (text fig. 1, *b*) with long, thickly chitinized styles; coxite with an elon-

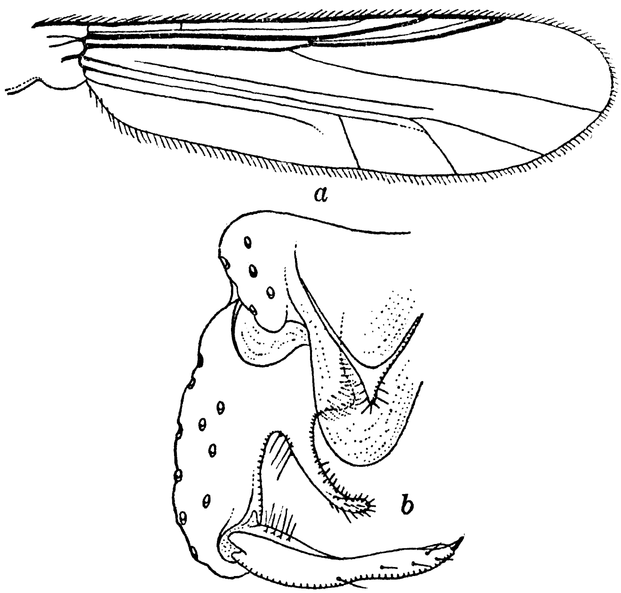

FIG. 1. *Spaniotoma (Smittia) bifurcata* sp. nov., male; *a*, wing; *b*, hypopygium.

gated distal and a blunt proximal projection on its dorsomesal margin; anal point thickened, with minute setæ on ventral side; anal tube large, distinctly projecting caudad, without setæ.

Habitat.—Tidal zone of gravelly shore, Japan.

Holotype.—Male; Masaki, Mie Prefecture; August 11, 1934.

Paratopotypes.—Males; August 11, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species closely resembles a European marine midge, *S.* (*S.*) *brevifurcata* Edwards, especially in the structure of the wing, but distinctly differs in the color of the halteres, the an-

tennal ratio, and the characteristic structures of the male hypopygium.

SPANIOTOMA (SMITTIA) ENDOCLADIÆ sp. nov.

This small black midge was found on the algal mats of *Endocladia complanata* and *Nemalion pulvinatum* on the upper tidal zone of rocky shores, and males were usually swarming low over the shore. The summer form is far smaller than the spring form, being about two-thirds the size of the latter.

Male.—Body length about 1.8 mm in the spring form and 1.2 mm in the summer form; ground color dull black; halteres dark brown.

Head setigerous; eyes densely pubescent with short hairs, reniform, widely separated from each other; distance between them greater than the vertical diameter of the eyes (14 : 11); frontoclypeus setigerous with many black setæ. Maxillary palpi 4-segmented (10 : 25 : 28 : 40); antennæ plumose, 13-segmented; terminal segment with one apical seta in addition to three basal setæ, not crowned with apical pubescence, shorter than the preceding three segments taken together (34 : 40), but longer than the two segments taken together (34 : 26); antennal ratio about 0.2.

Pronotum larger, not incised at dorsomeson, with two or three fine setæ on either lateral margin; pseudosutural fovea setigerous with about six erect setæ, which arise from large hyaline punctures of the integument; supra-alar setæ three; scutellum with two pairs of black setæ; postscutellum with a brown median stripe.

Wings (Plate 1, fig. 3) slightly brown under transmitted light, without macrotrichia on the membrane; squama bare; anal lobe obtuse. Protrusion of the costa indistinct; R_{2+3} extended close along vein R_{4+5}, ending on costa not far separated from the end of R_{4+5}; straight, ending slightly before the level of the end of M_{3+4}; r-m very short, slightly oblique; M_{1+2} very slightly bent caudad; fCu well beyond the crossvein; M_{3+4} almost straight; Cu_1 distinctly bent caudad at middle; 1st A short, atrophied under fCu.

Legs scantily setigerous with short setæ; proximal four tarsal segments of each leg provided with paired apical spurs; foreleg with bare tibial spur; middle leg with only one tibial spur; tibial comb of hind leg consisting of eight loosely arranged spinules; claws spatulate and finely serrate into four teeth at tip; pulvilli present but very small; relative lengths of

the segments of legs as follows: 27 : 33 : 17 : 12 : 8 : 4 : 4 in the foreleg, 34 : 35 : 18 : 9 : 7 : 4 : 4 in the middle leg, and 32 : 35 : 20 : 10 : 9 : 4 : 4 in the hind leg.

Abdomen slender; hypopygium (Plate 1, fig. 6) setigerous; ninth tergum separated by a median membrane into lateral halves, scantily setigerous on its caudal end; coxite slender, with a distinct basal projection and a mesal concavity; style broad, with a strong terminal spine.

Female.—Body slightly shorter than in the male, dark brown in general appearance. Antennæ 6-segmented (13 : 28 : 16 : 15 : 17 : 31); terminal segment with only one apical seta; maxillary palpi 4-segmented (10 : 21 : 26 : 43). Proportional lengths of the segments of legs as follows: 23 : 29 : 15 : 8 : 6 : 3 : 3 in the foreleg, 33 : 35 : 28 : 8 : 6 : 3 : 3 in the middle leg, and 30 : 33 : 16 : 7 : 7 : 3 : 3.5 in the hind leg; fourth tarsal segment of the hind leg slightly shorter than fifth (17 : 20); claws simple. Wings broader than in the male; cells R_1 and R_{2+3} slightly fuscous; vein R_{2+3} indistinct, closely extending along the slightly swollen R_{4+5}. Cercus somewhat triangular in lateral aspect, setigerous with long setæ, its dorsal angle distinct; ultimate sternum highly setigerous on its caudal area along the U-shaped incision. Other structures closely resembling those of the male.

Habitat.—Upper tidal zone of rocky shore, Japan.

Holotype.—Male; Seto, Wakayama Prefecture; April 19, 1934.

Allotopotype.—Female; April 19, 1934.

Paratypes.—Males and females; Yukawa and Seto, Wakayama Prefecture; June 22, 1930, and April 7 to 19, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species may belong to group B of the subgenus *Smittia* because of the pubescence of compound eyes, although it does not agree satisfactorily with other members of this group in the venation of the wings and the presence of the vestigial pulvilli. The species closely resembles *Spaniotoma marina* (Saunders), but differs in the structures of the male hypopygium and spermathecæ and in the color of the halteres. In the structures of the wing and male hypopygium the present species is closely similar to *Cricotopus fucicola* Edwards, but distinctly different in important generic characters: Thoracic notal setæ erect and arising from large, hyaline punctures squama of wing without setæ, and R_{2+3} ending distinctly beyond the middle between R_1

and R_{4+5}; and the female of the present species is provided with 6-segmented antennæ, differing from the 7-segmented antennæ of the latter species and moreover different in the color of the halteres, the relative lengths of the segments of legs, and the value of the male antennal ratio.

SPANIOTOMA (PSECTROCLADIUS) YUKAWANA sp. nov.

This yellow species was running on the gravelly seashore of an oyster bed and also collected at light ashore.

Male.—Body 2.4 to 2.8 mm long, ground color yellow; scutum with four black vittæ, middle pair yellowish brown or deep yellow in some cases; postscutellum black on its caudal half, with a yellow median line; venter of mesothorax brown or yellowish brown; pleuron of mesothorax with a black spot near wing base in some cases; each abdominal segment with a black median marking on tergum; forelegs brown; tarsal segments of middle and hind legs also brown.

Head yellowish white; eyes bare, reniform, widely separated from each other; distance between them greater than vertical diameter of eye (16 : 12) and equal to 0.57 of head width; frontoclypeus and vertex setigerous with short yellow setæ. Maxillary palpus 4-segmented (22 : 35 : 35 : 40); second segment of palpus with a sensory disc consisting of a group of hyaline trichoid sensillæ; antenna not plumose, 11-segmented, but the constrictions between the flagelial segments obscure and the four segments from seventh to tenth appear to be fused; each segment with three short setæ; terminal segment with an apical seta, somewhat longer than the pedicel (33 : 30) and slightly shorter than the preceding five segments taken together (33 : 36); antennal ratio about 0.38 to 0.39.

Pronotum distinct, with a large median, V-shaped incision, setigerous all over; pseudosutural foveæ setigerous with suberect yellow setæ; scutellum highly setigerous; supra-alar setæ seven.

Legs without long setæ, comparatively stout; claws simple; pulvilli very large, padlike, as long as the claws; empodium slender, slightly longer than the claws; tibial spurs large, pubescent basally, one on the fore tibia, two on each tibia of middle and hind legs; comb of hind tibia consisting of about fifteen large spines, which are longer than the shorter tibial spur; fore tarsal segments without apical spurs; proximal two tarsal segments of middle and hind legs each with strong, paired, apical spurs. Proportional lengths of the segments of legs as follows: 63:67:36:21:15:10:8 in the foreleg, 59:61:22:14:10:7:6

in the middle leg, and 68 : 75 : 38 : 21 : 17 : 9 : 7 in the hind leg.

Wings (Plate 1, fig. 4) comparatively broad, without macrotrichia on the membrane, brown under transmitted light; veins R, R_1, and R_{4+5} setigerous; squama entirely fringed with yellow setæ; anal lobe obtuse. R_{2+3} ending slightly before the middle between the ends of R_1 and R_{4+5}; R_{4+5} almost straight; costa produced beyond the tip of R_{4+5}; r-m oblique; M_{1+2} almost straight, ending at tip of wing; fCu beyond level of r-m; M_{3+4} straight, continuing the direction of the stem, ending on wing margin at opposite side of the end of R_{4+5}; Cu_1 almost straight; 1st A slightly beyond fCu. Halteres yellow.

Abdomen with short yellow setæ, those of tergum arising from distinct hyaline punctures of the integument; hypopygium (Plate 1, fig. 8) with distinct anal point; coxites without mesal lobes; styles slender, scantily setigerous, each with a small black bristle on its tip.

Female.—Body 2.8 to 3 mm long, ground color yellowish white; thoracic vittæ paler than in male, largely yellow; abdominal marking yellowish brown. Head white; distance between compound eyes on vertex far greater than vertical length of eyes (15 : 11) and 15 : 26 in ratio to head width; maxillary palpus 4-segmented (20 : 33 : 34 : 39); antennæ usually 6-segmented (14 : 35 : 18 : 20 : 16 : 30) and at most 8-segmented (14 : 22 : 16 : 18 : 20 : 16 : 11 : 21), in the former case second and third, and seventh and eighth, respectively, are fused; each flagellar segment with three or five setæ besides long, hyaline, trichoid sensillæ; ultimate segment with an apical seta. Thorax more setigerous than in the male. Vein R_{4+5} slightly curved along costal margin; M_{3+4} also very slightly curved; Cu_1 slightly sinuous; 1st A well beyond fCu; and lobe larger than in male. Legs provided with large pulvilli, as in male; relative lengths of the segments as follows: 58 : 64 : 35 : 20 : 14 : 9 : 7 in the foreleg, 55 : 58 : 20 : 12 : 9 : 6 : 6 in the middle leg, and 63 : 74 : 37: 19 : 16 : 8 : 7 in the hind leg. Hypopygium yellow; eighth sternum with a large U-shaped caudal incision, setigerous on its caudal region; spermathecæ two, large, completely spherical; cerci (Plate 2, fig. 11) yellow, comparatively small, discoidal, setigerous. Other structures as in the male.

Habitat.—Seashore; Japan.

Holotype.—Male; Yukawa, Wakayama Prefecture; April 12, 1934.

Allotopotype.—Female; April 12, 1934.

Paratopotypes.—Males and females; April 11 and 12, 1934.

Type specimens.—Alcoholic; deposited in the entomological laboratory of Kyoto Imperial University; collected by M. Tokunaga.

This species somewhat resembles the *Orthocladius* group in general appearance, but the large padlike pulvilli present a character of the *Psectrocladius* group. Another group, *Hydrobaunus* Fries, shows structures similar to those of the present species in the absence of the plumose hairs of the male antennæ and the absence of the basal appendages of the coxite, but differs in the short fourth tarsal segments, which are shorter than the fifth. The present species is distinct among the known species of *Psectrocladius* in the small value of the antennal ratio, the less-segmented and nonplumose antennæ of the male, and the absence of mesal lobes of the male hypopygium.

TANYTARSUS BOODLEÆ Tokunaga.

Tanytarsus boodleæ TOKUNAGA, Philip. Journ. Sci. **51** (1933) 358–360.

The immature forms, both larvæ and pupæ, are closely similar in structure to those of *T. halophilæ* Edwards (1926) and are distinctly different from the majority of this genus described by Bause (1913) in the absence of the prothoracic respiratory horns of the pupa, and the incomplete development of the antennal base, abdominal plumose setæ, and anal gills of the larva.

Pupa.—Body about 3 mm long; exuvia hyaline, head, thorax, and hypopygium yellow.

Head with paired brown setæ on the vertex; basal portion of antennal sheath forming a papiliform, hornlike projection. Thorax without trace of thoracic respiratory horns; thoracic integument not imbricate, scantily setigerous; a pair of small setæ on cephalic margin of pronotum, a setal group consisting of a long and a fine bristle on the laterocephalic part where the respiratory horn would be expected, a very long and one or two short setæ on the lateral side before wing base, two closely associated setæ on cephalomeson of scutum, long and short, closely associated setæ on caudoscutal part and a few, scattered, sensory pores and minute sensillæ; two or three minute tubercles on cephalic part of pseudosutural fovea.

Abdominal ornamentation consisting of pairs of small, round, dorsal, spinulous spots on second to sixth segments and paired lateral streaks of chitinization on first to eighth segments; all

dorsal spinulous spots subequal in size; transversal spinulous ridge of second abdominal segment extending straight along entire caudal margin of tergum, composed of a single row of recurved hooklets; lateral swimming lobes not distinct except for those of ultimate two segments; second segment with small, paired, lateral swellings each with a seta. Typical arrangement of abdominal setæ as follows: On dorsal side one pair on meson caudad of paired spinulous spots, one pair on lateral side of caudal part, and one pair on caudal margin; on ventral side two pairs on lateral side of middle part and one pair on caudal margin and on each lateral side one seta on dorsocephalic part, one on ventrocephalic and one on ventrocaudal part. Eighth segment provided with long setæ and in female its sternum forming small, double, caudal lobes; setal arrangement as follows: A pair of small setæ on caudal part of either side of venter and dorsum, a pair of long setæ on each caudal margin of sternum and tergum and on the lateral lobe a long seta on dorsum and three very long setæ on venter; structure of spinulous combs of eighth segment, which are found on the laterocaudal corners, highly different from those of the allied marine species, *T. halophilæ* and *T. maritimus*, spines being fused into a chitinization which is bluntly serrate into two or three teeth (Plate 2, fig. 19). Ultimate segment with large swimming paddles each of which is fringed with about forty long flattened setæ and with two very long dorsal setæ; dorsum of this segment without chitinized tubercules and instead of these tubercules with a pair of small swellings of hyaline integument; genital sheaths in male extending caudad far beyond caudal margin, in female these extend caudoventrad slightly beyond caudal margin of eighth segment.

Larva.—Full grown form about 5 mm long; greenish white in life.

Head brown, oval; two, small, black, spherical eyespots on either side, subequal to and distinctly separated from each other; front elongate, with two pairs of slender setæ on lateral side of cephalic part; each lateral half of vertex with three slender setæ on laterocephalic part and with three sensory pores—one on caudodorsal, one on cephalodorsal, and the other on laterocephalic part—postclypeus thickened, narrow, with a pair of slender setæ; preclypeus also thickened, somewhat trapezoid, with two pairs of long setæ, posterior pair on lateral membrane and anterior pair on thickened plate; clypealiæ, tormæ, and

labraliæ of usual form; labrum hyaline, with many marginal appendages: A pair of minute setæ along cephalic margin of preclypeus, two large comblike appendages (Plate 2, fig. 22, *a*) articulated on a common basal thickening on meson, a pair of long appendages finely fringed and spatulate at tip on meson or dorsad of the former comblike appendages, five pairs of slender spatulate appendages and two pairs of simple, small, accessory appendages on the lateral side; at apex of labrum another chitinized comb (Plate 2, fig. 22, *b*); epipharynx also provided with various appendages: Small paired combs (Plate 2, fig. 22, *c*) on meson of cephalic area, three closely associated simple spines and two plumose spines along arm of V-shaped median thickening (Plate 2, fig. 22, *d*). Premandible (Plate 2, fig. 24) with five flattened teeth, and a fleshy pubescent projection on its mesal side. Antennæ (Plate 2, fig. 23) 5-segmented (20 : 5–7 : 4–5 : 4–4.5 : 1.5); proximal segment with a large sensory pore at base, a sensory hair on the dorsal side, and a biramous, hyaline, trichoid sensilla on apex; other segments without these structures. Mandibles each with five teeth; distadentis slightly smaller than the adjacent largest tooth; a sharp, hyaline, spinelike projection along distal side of first tooth; a hyaline seta arising from base of distadentis and extending as far as tip of mandible; suprabrustia consisting of about eight strong setæ arranged in a single row; infrabrustia composed of finely serrate setæ; two large ordinary setæ and a large sensory pore arranged in the usual positions. Maxillæ (Plate 2, fig. 20) membranous, each with two very long setæ, the setæ on a common basal thickening on maxacoria; lacinial lobe with many sensory appendages; maxillary palpus 3-segmented; two slender setæ and four sensillæ near base of palpus. Mentum (Plate 2, fig. 21) with a large triangular median tooth which carries a small denticle on either side and four pairs of lateral teeth of which the first teeth are very large, subequal in size to the median tooth; lateral lamellæ of the mentum very large, narrowly extended straight laterad, not fanlike in shape; a pair of strong bladelike setæ on base of mentum.

Thorax scantily setigerous with very slender setæ; prothoracic pseudopods distinctly bilobed, studded with numerous yellow hooklets on ventral side; hooklets not fringed or serrate; paired setal groups composed of two or three, distinct, closely associated bristles on ventromeson of each thoracic segment.

Each abdominal segment with comparatively large setæ on lateral side; a double seta (Plate 2, fig. 25) located on caudal part of each lateral side from second to fifth segments, these setæ not plumose, differing from the study of Bause; each preanal dorsal tubercle with eight long setæ on apex and two small setæ on lateral side; one anal seta on either side; posterior pseudopods completely separated, each with a short seta on base and sixteen golden claws, which are semicircularly arranged; shape of claws closely similar to those of *T. halophilæ*.

Habitat.—Immature forms found within the mud tubes built on the matting of the littoral alga, *Boodlea coactata,* on the bottom of the tide pool, spacially associated with *Pontomyia pacifica.* The larvæ mainly feed on the algal débris, and a small quantity of diatoms was usually found in the stomach of the larvæ. From the northern coast of Kyushu, Karatsu Bay, Saga Prefecture, many males of this species, which were swarming over a tide pool, were collected by Mr. Y. Yoshimura (August 7, 1934) to whom I express my hearty thanks for this valuable material, which establishes a new locality for this species.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Spaniotoma* (*Smittia*) *littoralis* sp. nov., male wing.
2. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., male wing.
3. *Spaniotoma* (*Smittia*) *endocladiæ* sp. nov., male wing.
4. *Spaniotoma* (*Psectrocladius*) *yukawana* sp. nov., male wing.
5. *Spaniotoma* (*Smittia*) *littoralis* sp. nov., male hypopygium.
6. *Spaniotoma* (*Smittia*) *endocladiæ* sp. nov., male hypopygium.
7. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., male hypopygium.
8. *Spaniotoma* (*Psectrocladius*) *yukawana* sp. nov., male hypopygium.
9. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., spermatheca.
10. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., female cercus.

PLATE 2

FIG. 11. *Spaniotoma* (*Psectrocladius*) *yukawana* sp. nov., female cercus.

FIGS. 12 to 18. *Spaniotoma* (*Smittia*) *nemalione* sp. nov., immature forms; *12*, ultimate segment of male pupa, dorsal aspect; *13*, ultimate segment of female pupa, dorsal aspect; *14*, larval antenna; *15*, infrabrustia of larval mandible; *16*, larval maxilla, ventral aspect; *17*, larval mentum; *18*, larval premandible.

19 to 25. *Tanytarsus boodleæ* Tokunaga, immature forms; *19*, caudolateral combs of penultimate segment of pupa; *20*, larval maxilla; *21*, larval mentum; *22*, various appendages of labrum and epipharynx, labralia omitted, cephalic aspect; *23*, larval antenna; *24*, larval premandible; *25*, double seta of larval abdomen.

TEXT FIGURE

FIG. 1. *Spaniotoma* (*Smittia*) *bifurcata* sp. nov., male; *a*, wing; *b*, hypopygium.

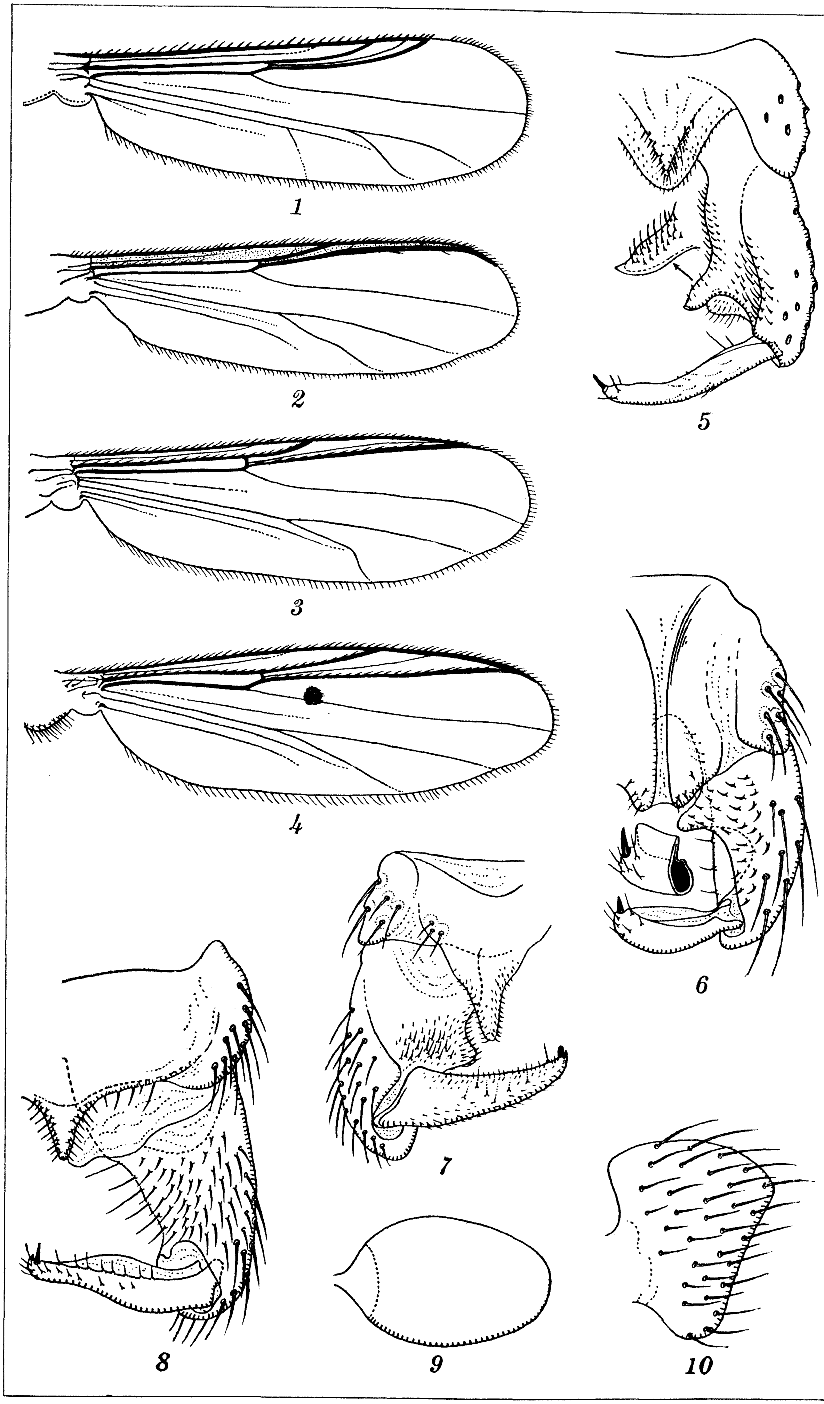

PLATE 1.

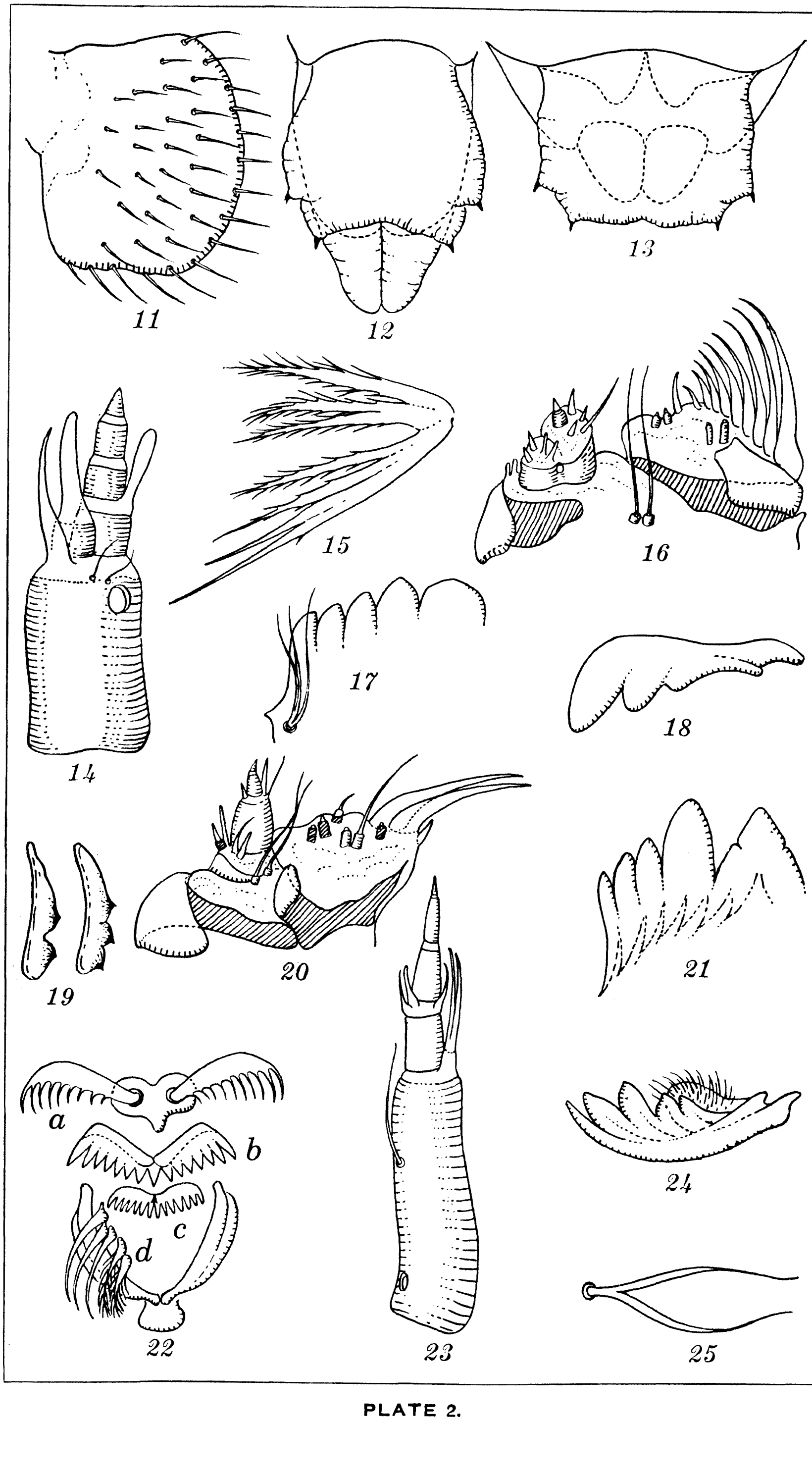

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXI [1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

FOUR PLATES

The very interesting crane flies discussed herewith were taken by Rev. Mr. George M. Franck on Mount Omei, Szechwan, western China, chiefly at high altitudes. I am greatly indebted to Mr. Franck for this continued interest in saving the small and medium-sized species of Tipulidæ, flies that are usually overlooked by the general collector. The types of the novelties are preserved in my collection of these flies. The present report adds the following generic and subgeneric groups to the already large list known from China: *Stibadocerella, Discobola, Franckomyia,* and *Ptilostenodes.*

TIPULINÆ

TIPULA (TRICHOTIPULA) LONGIFIMBRIATA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

General coloration of mesonotal præscutum almost uniformly dark brown; wings obscure yellow, many of the veins seamed with brown; numerous macrotrichia in cells beyond cord and in outer ends of some of the more basal cells; cell M_1 sessile or nearly so; male hypopygium with caudal margin of tergite bearing a divaricate blackened fork; inner dististyle produced behind into a short taillike extension.

Male.—Length, about 11 millimeters; wing, 11.5.

Frontal prolongation of head relatively short, brownish black, brighter dorsally at base; nasus distinct; palpi black. Antennæ (male) relatively long, if bent backward extending nearly, if not quite, to base of abdomen; scape and pedicel yellow; flagellum black; basal enlargements of segments scarcely indicated, the segments being nearly cylindrical; longest verticils subequal to segments; terminal segment about one-third the length of the penultimate. Front and anterior vertex obscure yellow; posterior sclerites of head brownish gray.

[1] Contribution from the entomological laboratory, Massachusetts State College.

Pronotal scutum dark brown, the scutellum yellow. Mesonotal præscutum almost uniformly dark brown, without evident stripes in the unique type; scutal lobes blackened, the median area yellowish testaceous; scutellum testaceous, clearer yellow medially; mediotergite brownish yellow. Pleura yellow, variegated with darker on the mesepisternum. Halteres obscure yellow. Legs with the coxæ yellow, the fore coxæ a trifle darkened; trochanters yellow; femora light brown, the tips passing into dark brown; tibiæ dark brown, the tips narrowly blackened; tarsi black; claws (male) with a single erect spine at near midlength. Wings (Plate 1, fig. 1) with the ground color yellow, variegated by brown seams to many of the veins, including the cord, outer end of cell 1st M_2, vein Cu except near outer end, and vein 2d A; outer longitudinal veins more narrowly seamed with brown; extensive paler clouds occupying most of cell 1st A; stigma dark brown; veins brown; macrotrichia black. Abundant macrotrichia in all cells of wing beyond cord, and in outer ends of cells C, R, M, Cu, and 1st A basad of cord (indicated in figure by stippled dots); base of cell 1st M_2 nearly destitute of trichia. Venation: Cell M_1 narrowly sessile or very short-petiolate; m-cu close to fork of M_{3+4}; cell 2d A of moderate width.

Abdominal tergites dark brown, narrowly ringed caudally with testaceous-yellow; sternites more brownish yellow; hypopygium brown. Male hypopygium (Plate 2, fig. 25) with the tergite, *9t*, almost completely separated from the sternite by extensive pale membrane; basistyle, *b*, elongate, separated from the ninth sternite, *9s*, by an unusually long, straight, ventral suture. Ninth sternite, *9s*, viewed from beneath widely filled with pale membrane, the narrow strip delimited beneath the suture with a fringe of unusually long setæ, directed ventrad; a compact oval patch at cephalic portion of row bears more delicate silken setæ. Ninth tergite, *9t*, with the caudal margin transverse, the median area produced caudad into two, blackened, divergent horns, their tips directed very slightly ventrad. Outer dististyle, *od*, short and broad, the apex truncate, the surface with numerous short setæ. Inner dististyle, *id*, complex, the beak portion blackened, shallowly bifid, beneath this with a second, blackened, fingerlike lobe; apex of style superimposed beneath the blackened beak as a slender pale lobe; caudal portion of style produced backward as a short taillike point. Eighth sternite, *8s*, relatively small, with caudal border gently convex, the entire surface with sparse, scattered, black setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*).

The general appearance and the wing pattern of the present fly are much as in *Tipula* (*Trichotipula*) *polytricha* Alexander, differing in the glabrous basal cells of the wing, nearly sessile cell M_1, and, especially, the details of structure of the male hypopygium, including the ninth tergite, ninth sternite, and styli.

TIPULA (TRICHOTIPULA) MALLOPHORA sp. nov. Plate 1, fig. 2; Plate 2, fig. 26.

Allied to *longifimbriata;* entire mesonotum dark brown; thoracic pleura dark brown, variegated by paler on the dorsal sternopleurite and pteropleurite; wings with pattern less contrasted, obscure yellow and dark brown; petiole of cell M_1 exceeding m; abdominal tergites and hypopygium brownish black; inner dististyle with a long pale blade, extending backward from the caudal portion.

Male.—Length, 10 to 11 millimeters; wing, 11 to 12.

Female.—Length, about 12 millimeters; wing, 10.5.

Frontal prolongation of head and palpi dark brown. Antennæ with scape and pedicel obscure yellow; flagellum brownish black; flagellar segments with basal enlargements feebly developed; longest verticils shorter than the segments; terminal segment only about one-fourth the length of the subterminal. Head dark brown, very narrowly darker on orbits.

Mesonotum uniformly dark brown, without indications of markings. Pleura dark brown, paler on the dorsal sternopleurite, pteropleurite, and meron. Halteres elongate, the stem dusky except at the narrow yellow base, the apex of knob yellow. Legs with the coxæ brownish testaceous; trochanters brownish yellow; femora brown, the tips passing into darker brown; remainder of legs dark brown, the tarsi passing into black; claws with a strong erect spine before midlength. Wings (Plate 1, fig. 2) with the very restricted ground color obscure yellow, almost obliterated by very extensive brown clouds and seams, appearing chiefly as pale central streaks in the outer radial and medial fields; a spot near outer end of cell M, a seam along vein 1st A, and a spot near outer end of cell 1st A, not far from vein 2d A; cells before cord chiefly of a uniform brown; stigma oval, darker brown; veins dark brown. Abundant macrotrichia in cells of outer two-thirds of wing (shown in figure by stippled dots), lacking in cells near wing base and in all but extreme outer end of cell Sc. Venation: Petiole of cell M_1 longer than m.

Abdominal tergites and hypopygium brownish black, the sternites more reddish brown; basal sternites more darkened medially, the outer segments more uniformly darkened. Male hypopygium (Plate 2, fig. 26) generally as in *longifimbriata* sp. nov., differing especially in the conformation of the ninth tergite and inner dististyle. Arrangement of setæ on ventral margin of ninth sternite very similar in both species, but differing in size and number of the hairs. Ninth tergite, *9t*, with a median blackened plate that splits at apex into two, feebly divergent, acute spines. Inner dististyle, *id*, very complex in structure, produced behind into a long, pale, compressed blade that is slightly constricted near base; two apical, blackened beaks, both slender, acute, and separated from one another only by a narrow slit; the long, pale, cephalic portion of the style bears on outer or dorsal margin a pale lobe whose edge is ragged or fimbriolate.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Allotype, female, White Cloud Temple, altitude 9,000 feet, July 29, 1935 (*Franck*). Paratype, male, with the allotype.

The nearest ally is undoubtedly *Tipula* (*Trichotipula*) *longifimbriata* sp. nov. The present fly is most readily told by the petiolate cell M_1 and by the details of structure of the male hypopygium, notably the long, pale, caudal blade of the inner dististyle.

TIPULA (SCHUMMELIA) MEMBRANIFERA sp. nov. Plate 1, fig. 3; Plate 2, fig. 27.

Belongs to the *continuata* group; antennal flagellum black; thoracic pleura yellow, the mesepisternum infuscated; femora obscure yellow, the tips rather narrowly blackened; wings infumed, restrictedly variegated by darker brown and yellow areas; cell 1st M_2 small; male hypopygium with the ninth sternite produced ventrad into long, pale, membranous points on either side of midline.

Male.—Length, about 11 millimeters; wing, 12.5; antenna, 4.

Frontal prolongation of head yellow; nasus distinct; palpi brownish black. Antennæ with scape and pedicel brownish yellow; basal flagellar segment brown, the distal third, together with remainder of organ, black; basal enlargements of segments moderately developed; longest verticils unilaterally arranged, a trifle shorter than the segments. Head with front and anterior vertex yellow; posterior vertex brown.

Pronotum brown. Mesonotal præscutum chiefly covered by three brown stripes, the median one further split by a darker brown capillary vitta; posterior interspaces infuscated, the humeral and lateral portions of præscutum broadly yellow; scutal lobes dark brown, the median area paler; scutellum obscure yellow, vaguely darkened medially; postnotum chiefly yellow. Pleura yellow, the dorsopleural region and mesepisternum infuscated. Halteres yellow, the base of knobs infuscated, the apex pale yellow. Legs with the coxæ yellow; trochanters obscure yellow; femora obscure yellow, the tips rather narrowly blackened, a little more broadly so on the fore and middle legs where about the distal sixth is included; tibiæ and tarsi black; claws with long basal spine at near proximal third. Wings (Plate 1, fig. 3) with a strong brownish tinge, restrictedly variegated by darker brown and pale yellow areas; cells C and Sc about of the ground color; stigma oval, dark brown; broad brown seams on m-cu and distal section of Cu_1; yellow areas before and beyond stigma and across base of cell 1st M_2, the last extending into proximal portion of cell M_3; a major yellowish area near outer end of cell M; bases of cells Cu, 1st A, and 2d A a trifle brightened; veins brown, the obliterative areas at fork of M pale. Venation: Rs a little longer than m-cu; cell 1st M_2 small, pentagonal; cell M_1 short-petiolate, the stem a little longer than m; m-cu close to fork of M_{3+4}.

Abdomen with basal four tergites obscure yellow, darker dorsally; outer segments black, the hypopygial appendages pale. Male hypopygium (Plate 2, fig. 27) with the suture between tergite, 9*t*, and sternite, 9*s*, nearly complete; basistyle not evidently separated from sternite. Ninth sternite, 9*s*, on either side produced ventrad into a long, pale, membranous lobe, gradually narrowed to a subacute point, shortly before the free tips united across the midline. Ninth tergite, 9*t*, broadly notched medially, as in the group; lateral lobes broadly rounded, their margins narrowly blackened; base of notch with a very low obtuse lobule. Outer dististyle, *od*, gently arcuated, of moderate length. Inner dististyle, *id*, with the outer margin conspicuously blackened, the outer apical portion extended into a blunt point; two blackened denticles, the more basal one smaller. Eighth sternite, 8*s*, narrow, without lobes or modifications; setæ small and sparse.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

The present fly is readily told from other allied species of *Schummelia* by the wing pattern and venation, and the somewhat remarkable development of pale membrane of the ninth sternite of the male hypopygium. The closest ally is the next-described species, *Tipula* (*Schummelia*) *dissociata* sp. nov.

TIPULA (SCHUMMELIA) DISSOCIATA sp. nov. Plate 1, fig. 4; Plate 2, fig. 28.

Generally similar and closely allied to *T.* (*S.*) *membranifera* sp. nov., differing especially in the details of body and wing coloration, venation, and structure of the male hypopygium.

Male.—Length, about 11 millimeters; wing, 12.

Frontal prolongation of head without clearly defined nasus. First flagellar segment shorter, but succeeding segments longer, than in *membranifera*. Posterior portion of head conspicuously dark brown. Median præscutal stripe not divided by a capillary darker brown vitta. Dark pleural girdle on mesepisternum dark brown, distinct. Apices of knobs of halteres only slightly brightened. Wings (Plate 1, fig. 4) with ground color slightly darker brown; cell Sc dark brown, contrasting conspicuously with the yellow cell C. Venation: Cell 1st M_2 more elongate; m-cu at near midlength of M_{3+4}. Male hypopygium (Plate 2, fig. 28) without a median lobule on caudal margin of ninth tergite. Outer dististyle, *od*, longer and more attenuated. Inner dististyle, *id*, with the blackened lobes of distinct conformation, as shown.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, July 27, 1935 (*Franck*).

TIPULA (SCHUMMELIA) DISSOCIATA TIMENDA subsp. nov.

Female.—Length, about 13 millimeters; wing, 14.

As in the typical form, differing as follows: Nasus evident, slender. Pronotum clear light yellow throughout. Posterior interspaces of præscutum yellow; median region of scutum yellow; scutellum and mediotergite uniformly yellow, without markings. Pleura yellow, not or only insensibly variegated by darker on anepisternum. Apices of knobs of halteres clear yellow. Legs with femoral tips broadly blackened. Wings with cell M_1 narrowly sessile. Abdominal tergites chiefly brownish black, the first segment and sides of the second yellow; succeed-

ing tergites vaguely brightened by obscure yellow areas; subterminal segments uniformly blackened.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

TIPULA (ACUTIPULA) FORTICAUDA sp. nov. Plate 1, fig. 5; Plate 2, fig. 29.

Mesonotum gray, the pleura, including ventral half of pleurotergite, yellow, unmarked; wings with cell C, prearcular region, and stigma light brown, cell Sc uniformly darker brown; a dark cloud at near midlength of cell Cu; abdomen dorsally uniform dark gray, the lateral borders narrowly buffy, margined internally by dark brown; male hypopygium large; ninth tergite simple; inner dististyle with the outer lobe produced into a pendant trunklike portion; caudal margin of eighth sternite weakly bilobed, with conspicuous setæ.

Male.—Length, about 15 to 16 millimeters; wing, 17 to 18.

Frontal prolongation of head dark brown; nasus long and distinct; palpi black. Antennæ with scape and pedicel obscure yellow; first flagellar segment brownish yellow, the remaining segments brownish black; verticils exceeding the segments in length. Head dark brownish gray, the orbits restrictedly paler gray.

Pronotum obscure yellow. Mesonotal præscutum ashy gray with three, scarcely differentiated, brownish gray stripes, the interspaces obscure; extreme cephalic border of præscutum infuscated; posterior sclerites of mesonotum, including the dorsal half of pleurotergite, gray; parascutella yellow. Pleura uniformly light yellow, the dorsopleural membrane a trifle more dusky. Halteres dark brown. Legs with the coxæ and trochanters light yellow; femora obscure yellow, passing into more brownish yellow, the tips narrowly blackened, the amount subequal on all legs; tibiæ brownish black; tarsi passing into black. Wings (Plate 1, fig. 5) with cell C, prearcular region, and stigma light brown; cell Sc much darker brown throughout; general coloration of remainder of wing pale brown, clearer before cord and in basal portions of cells M and Cu; dusky clouds at outer end of cell M and at near midlength of cell Cu; veins dark brown. Venation: Rs a trifle longer than m-cu; petiole of cell M_1 and m subequal.

Abdomen dorsally uniformly dark gray, the lateral borders of the tergites narrowly buffy, margined internally with dark brown; extreme caudal borders of tergites two to four pale;

basal sternites yellow, beyond the second passing into brownish black; hypopygium very large and powerfully constructed, uniformly darkened. Male hypopygium (Plate 2, fig. 29) with the ninth tergite, 9*t*, bearing a moderately broad median lobe that is further narrowed at near two-thirds the length into a simple, blackened, spinulose point. Styli as figured; outer style, *od*, obliquely truncated at apex. Inner dististyle, *id*, with the beak portion heavily blackened, its own crest high; outer lobe of style prolonged into a glabrous trunklike portion, deflected towards the beak of the style, the outer apical angle further produced into a small point; setæ at crest of style powerful, about twenty in number. Eighth sternite, 8*s*, sheathing, the apex concave, each lateral lobe with numerous elongate setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, July 29, 1935 (*Franck*). Paratopotypes, 2 males.

The present fly bears a general resemblance to species such as *Tipula* (*Acutipula*) *quadrinotata* Brunetti, but is readily told from all regional allies by the unusually large hypopygium, with the median lobe of the tergite simple, and the inner dististyle of peculiar conformation.

TIPULA (ACUTIPULA) SUBINTACTA sp. nov. Plate 1, fig. 6; Plate 2, fig. 30.

General coloration of thorax yellow, the præscutum with four entire brown stripes; scutellum yellow, margined with dark brown; legs brown; wings dark, variegated by cream-colored areas before cord and as a continuous line across bases of outer medial cells; male hypopygium with the median lobe of tergite slender; inner dististyle with the outer lobe divided by a rounded notch into two lobes, each bearing groups of spinous setæ.

Male.—Length, about 16 millimeters; wing, 19.

Frontal prolongation of head brown; nasus distinct; palpi brownish black. Antennæ with scape and pedicel light yellow; flagellum brownish black; flagellar segments with basal enlargements relatively small; longest verticils subequal to the segments in length. Head dark brownish gray.

Pronotum dark brown. Mesonotal præscutum obscure yellow, with four entire brown stripes, the intermediate pair relatively narrow and clearly defined, separated by a conspicuous, yellow, median line; lateral stripes less clearly defined, laterally extending towards margin; scutum obscure yellow medially, the lobes extensively darkened; scutellum obscure yellow, conspicuously margined with dark brown; central portion of mediotergite

brown, the lateral and posterior portions yellow pollinose. Pleura yellow, the central portion of pleurotergite darker; dorsopleural membrane feebly darkened. Halteres infuscated, the apex of knob more whitened. Legs with the coxæ and trochanters yellow; remainder of legs uniformly brown, apparently not fully colored in the slightly teneral type. Wings (Plate 1, fig. 6) slightly teneral, but with the pattern entirely indicated; ground color dark, variegated by restricted cream-colored areas before cord, near base of cell 1st M_2, and as an oblique stripe across the basal portions of cells M_1 to M_4, inclusive; a small whitish spot at near two-thirds the length of cell M, adjoining vein Cu; pale areas on either side of the darkened spot lying before midlength of cell Cu; veins dark. Wings relatively narrow, the veins near stigma somewhat crowded. Venation: Rs subequal in length to m-cu; petiole of cell M_1 longer than m; m-cu a short distance before fork of M_{3+4}.

Basal abdominal segments chiefly obscure yellow, the outer ones darker, but not fully colored in the unique type. Male hypopygium (Plate 2, fig. 30) with the median lobe of ninth tergite, *9t,* unusually slender at apex, set with black spines; on ventral face of lobe with two carinæ that diverge slightly behind. Outer dististyle, *od,* broad, the apex produced into a moderately long lobe; setæ at inner margin near base long and conspicuous. Inner dististyle, *id,* with the beak slender; outer lobe deeply divided by a rounded notch into a broadly obtuse outer lobe, crowned with from twenty-five to thirty spinous setæ, and a narrower, more clavate, basal lobe, its apex produced into a decurved point, the outer surface with abundant spinous setæ. Eighth sternite broad at apex, provided with hair brushes.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

The nearest relative of the present fly seems to be *Tipula* (*Acutipula*) *intacta* Alexander, which has the hypopygium generally similar but differing in all details. The hypopygium is very different in structure from that of *T.* (*A.*) *omeiensis* Alexander and *T.* (*A.*) *yunnanica* Edwards, which have a somewhat similar wing pattern.

TIPULA (VESTIPLEX) AVICULAROIDES sp. nov. Plate 1, fig. 7; Plate 2, fig. 31.

Belongs to the *himalayensis* group; allied to *avicularia;* antennæ (male) elongate, the flagellum black; mesonotal præscutum

with the ground color yellow, with four brown stripes that are insensibly bordered by darker; scutellum and pleura chiefly black, pruinose; wings brownish yellow, very restrictedly variegated by cream-yellow spots; cells beyond cord uniformly of the ground color; basal four abdominal tergites reddish orange, with a narrow darkened dorsal stripe; outer abdominal segments, including hypopygium, black; basistyle with a spine.

Male.—Length, about 14 millimeters; wing, 15; antenna, about 6.5.

Frontal prolongation of head chestnut-brown laterally, darker above; nasus distinct; palpi black, the incisures narrowly pale. Antennæ elongate, as shown by the measurements; scape reddish brown, darkened apically; pedicel pale yellow; flagellum black; flagellar segments elongate, moderately incised, the verticils shorter than the segments; terminal segment tiny. Head light brown, the posterior orbits narrowly yellow, margined internally by a dusky line; posterior vertex with a continuous, black, median vitta.

Pronotum dark brown. Mesonotal præscutum with the ground color, including the interspaces, yellow, the lateral borders behind the pseudosutural foveæ blackish gray; four brown stripes that are insensibly bordered by slightly darker brown, most evident on mesal edges of lateral stripes and as paired submedian lines on intermediate stripes; scutum gray, the lobes conspicuously variegated by dark brown; scutellum black, the surface sparsely pruinose; mediotergite black, heavily pollinose with grayish yellow, with a capillary, median, black vitta. Pleura chiefly blackened, the surface sparsely pruinose; ventral pleurotergite yellow pollinose. Halteres brown, the knobs blackened. Legs with the coxæ dark gray; trochanters obscure yellow; femora obscure yellow basally, passing into brownish yellow, the tips broadly blackened; tibiæ and tarsi black. Wings (Plate 1, fig. 7) with the ground color almost uniformly brownish yellow, cell Sc and the prearcular field clearer yellow; restricted cream-colored spots, distributed as follows: Before stigma in cell R_1; across cell 1st M_2; in basal half and near outer end of cell M; extreme bases of cells Cu and 1st A; two tiny spots near outer end of cell 1st A; outer end of cell 2d A; no sign of brightening in outer radial or medial fields; veins dark, those in outer radial field somewhat paler brown. Venation: Cell 1st M_2 relatively long; m-cu just before fork of M_{3+4}; petiole of cell M_1 subequal to m.

Abdomen with basal four tergites reddish orange, with a narrow, black, continuous, dorsomedian vitta, the lateral borders of the basal two segments less evidently darkened; segments five to nine, inclusive, together with the hypopygial appendages, black, the surface sparsely pruinose. Male hypopygium (Plate 2, fig. 31) small, the basistyle, *b*, entirely separated from the sternite, its posterior angle produced dorsad into a powerful, broad-based, blackened spine, the tip acute. Ninth tergite, 9*t*, small, divided medially by pale membrane, the lateral lobes obtuse. Outer dististyle, *od*, relatively narrow, dusky, with abundant setæ. Inner dististyle, *id*, simple, the beak darkened, the posterior portion of style opposite the beak produced caudad into a yellow triangular flange. Ninth sternite, 9*s*, with a small, blackened, rounded lobe near margin of junction with basistyle, this structure apparently homologous with the bird's-head structure in *avicularia*. Ædeagus pale, jutting caudad from genital chamber, the acute tip strongly decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Nwa Nien Pin Temple, altitude 6,500 feet, July 31, 1935 (*Franck*).

The present fly superficially resembles species such as *Tipula* (*Vestiplex*) *avicularia* Edwards, *T.* (*V.*) *nigroapicalis* Brunetti, and *T.* (*V.*) *pleuracantha* Edwards, differing from all in the wing pattern, with no sign of a poststigmal brightening, and in the structure of the male hypopygium.

TIPULA (OREOMYZA) PROLONGATA sp. nov. Plate 1, fig. 8; Plate 3, fig. 32.

General coloration yellow, the præscutum with three pale brown stripes; antennæ (male) with basal three segments yellow, the remainder black; legs with tips of femora blackened, of the posterior pair narrowly so; wings tinged with dusky, cells C, Sc, and the stigma abruptly brownish black; prearcular region light yellow; outer abdominal segments blackened; male hypopygium with the tergite produced into two slender lobes, separated by a V-shaped notch; a single complex dististyle, produced caudad into a long, flattened, yellow blade.

Male.—Length, about 12 millimeters; wing, 13.

Female.—Length, about 15 millimeters; wing, 14.

Frontal prolongation of head obscure yellow, slightly darker laterally; nasus reduced to a small rounded papilla; palpi dark brown, the terminal segment extensively yellow on distal portion. Antenna (male) relatively long, if bent backward extending to

about midlength of the second abdominal segment; basal three segments light yellow, the remaining segments black; first flagellar segment unusually long, about one-half longer than the second; succeeding segments with basal enlargements feebly developed; verticils shorter than the segments. Front and anterior vertex yellow; posterior portion of head grayish brown, the posterior orbits a little brighter; an exceedingly delicate, capillary, median, dark line.

Pronotum yellow. Mesonotal præscutum with the dorsum almost uniformly pale yellowish brown, the three stripes scarcely darker and poorly delimited against the ground; lateral margins of præscutum yellow; scutal lobes feebly darkened; scutellum and mediotergite yellow. Pleura uniformly yellow. Halteres obscure yellow, the knobs darkened. Legs with the coxæ and trochanters yellow; femora yellow basally, soon passing into obscure yellow, the tips blackened, more broadly so on the fore and middle legs, narrowly so on the posterior femora; tibiæ and tarsi black; claws (male) with long basal spine. Wings (Plate 1, fig. 8) with a dusky tinge; cells C and Sc, together with the stigma and a confluent seam on anterior cord, brownish black; prearcular cells light yellow; posterior cord and longitudinal veins beyond cord very narrowly seamed with brown; veins brownish black to black, brightened in prearcular field. Venation: R_{1+2} entire; Rs long, nearly twice m-cu; petiole of cell M_1 shorter than m; M_{3+4} shorter than the basal section of M_{1+2}; cell 2d A narrow.

Abdomen with basal three tergites yellow, unmarked; succeeding two tergites darkened laterally; sixth and remaining segments black, sparsely pruinose; lateral borders of tergites five to eight, inclusive, broadly light gray; basal sternites yellow. Male hypopygium (Plate 3, fig. 32) with the tergite, *9t*, entirely separated from the sternite, *9s;* basistyle incompletely separated from sternite by a ventral suture, its outer end not at all produced; dististyle inserted unusually far ventrad. Ninth tergite, *9t*, a large, quadrate, blackened plate, its caudal margin further extended into a broad, depressed, blackened ledge that is deeply split by a V-shaped notch, the lateral lobes slender, with microscopic black spines on mesal face at apex. A single complex dististyle, *d*, the usual outer style reduced to a tiny lobe; main body of style produced caudad beyond the other elements of the hypopygium as a flattened yellow blade, the sides parallel,

the apex obtuse. Eighth sternite relatively small, without armature of modified lobes or setæ.

Female with the genital shield and bases of hypovalvæ intensely black; cerci horn-color, straight and slender, the tips gently decurved; hypovalvæ beyond base reddish horn-color, compressed.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, July 29, 1935 (*Franck*). Allotopotype, headless female, summit, altitude 11,000 feet, August 18, 1934 (*Graham*); United States National Museum.

In its general appearance, the present fly is much like *Tipula* (*Vestiplex*) *testata* Alexander, but belongs to a different subgeneric group, and is entirely distinct in the details of wing pattern and structure of the male hypopygium.

CYLINDROTOMINÆ

STIBADOCERELLA OMEIENSIS sp. nov. Plate 1, fig. 9.

General coloration greenish testaceous, the præscutum and scutum variegated with dark brown; antenna (male) about one-half longer than body, the flagellum whitish; fore tibiæ with base and apex broadly white; remaining tibiæ without a pale basal ring; basitarsi entirely dark brown; wings with second and third sections of vein M_{1+2} subequal; cell 2d A ending about opposite the proximal end of the arculus.

Male.—Length, about 9.5 millimeters; wing, 9.3; antenna, about 14.5.

Rostrum pale yellow; palpi black. Antennæ about one-half longer than the body; scape and pedicel pale green; flagellum whitish, the outer segments passing into pale green. Head greenish testaceous, smooth.

Pronotum pale greenish yellow. Mesonotal præscutum pale greenish with three dark brown stripes; scutal lobes similarly darkened; remainder of mesonotum pale testaceous. Pleura uniformly pale, the ventral sclerites, with the coxæ, with a strong greenish tinge, undoubtedly strongly marked and conspicuous in living individuals. Halteres elongate, the stem pale brown, the knob blackened. Legs with the coxæ and trochanters greenish testaceous; femora pale greenish brown, the tips somewhat darker; fore tibiæ with base broadly white, the tip similarly colored and nearly twice as extensive as the base; remaining

tibiæ pale greenish brown, with no indication of white rings, either at base or apex; all basitarsi brown; outer four tarsal segments of all legs white, with a distinct greenish tinge, the pretarsus darkened; basal third to fourth of second tarsal segment of fore and middle legs slightly darkened; posterior legs broken beyond midlength of tibiæ. Wings (Plate 1, fig. 9) crystal clear, with black veins. Venation: Sc_1 ending shortly before r-m, Sc_2 at its tip; basal section of Rs a trifle longer than the distal portion; basal section of M_3 long, arcuated, exceeding twice the length of m; third section of M_{1+2} subequal to second section of the same vein; cell 2d A ending about opposite the proximal end of arculus.

Abdomen pale yellowish brown, the pleural areas somewhat darker.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 5,500 feet, July 27, 1935 (*Franck*).

The present species is well distinguished from the three previously described in *Stibadocerella* by the whitish antennal flagellum, lack of a basal pale annulus on middle and posterior tibiæ, and the marked restriction of white color on the tarsi.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) OMNIFLAVA sp. nov. Plate 1, fig. 10; Plate 3, fig. 33.

General coloration pale yellow, the præscutum with a weakly indicated, brown, median stripe, restricted to anterior half; head black; antennæ 15-segmented, the flagellum chiefly yellow; legs yellow, only the terminal tarsal segments blackened; wings uniformly pale yellow; Sc_1 ending about opposite two-thirds the length of Rs, Sc_2 a little longer than Sc_1; R_{1+2} elongate; abdominal tergites darkened medially; hypopygium with the dististyle extended into a boomerang-shaped apical point; ædeagus terminating in two divergent points.

Male.—Length, about 9 millimeters; wing, 10.

Rostrum and palpi black. Antennæ 15-segmented, there being thirteen flagellar segments; scape black; pedicel dark brown; flagellum yellow, the outer three or four segments brownish yellow; basal flagellar segments oval, the outer ones elongate; terminal segment only a trifle shorter than the penultimate; verticils of outer segments shorter than the segments themselves. Head black; anterior vertex reduced to a narrow strip.

Cervical region brownish black. Pronotum and mesonotum pale yellow, the præscutum with a weakly indicated, more brownish, median stripe on its anterior half. Pleura pale yellow. Halteres relatively elongate, pale yellow, the knobs weakly darkened. Legs pale yellow, only the outer four tarsal segments blackened; tarsi relatively long and slender; claws with a single slender subbasal tooth. Wings (Plate 1, fig. 10) uniformly pale yellow; stigma not indicated; veins brownish yellow. Venation: Sc long, Sc_1 ending at near two-thirds the length of Rs, Sc_2 at tip of Sc_1; R_{1+2} long, nearly three times R_2 alone; cell 1st M_2 of moderate length; m-cu close to fork of M.

Abdominal tergites medially uniform dark brown, the sides pale yellow; sternites pale yellow; hypopygium obscure yellow, the dististyles chiefly darkened. Male hypopygium (Plate 3, fig. 33) with the tergite, *9t*, gently concave on central portion of caudal border. Basistyle with ventromesal lobe very obtuse, occupying most of mesal face of style. Dististyle, *d*, with base slightly dilated, dusky, the long apical yellow point more or less boomerang-shaped, slightly compressed, with a longitudinal lateral carina. Gonapophyses, *g*, heavily blackened at, and back from, the acute tips. Ædeagus, *a*, broad, terminating in two divergent points, the surface of outer half microscopically scabrous.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

By keys to the species of *Limonia* in the western Palæarctic fauna the present fly runs to *Limonia* (*Limonia*) *stigma* (Meigen), which has a very different hypopygium. There is no very close ally in the eastern Palæarctic Region.

LIMONIA (LIMONIA) TESSELLATIPENNIS sp. nov. Plate 1, fig. 11; Plate 3, fig. 34.

General coloration yellow, the præscutum with three incomplete brownish black stripes, the short lateral pair bent laterad at anterior ends, reaching the margin; knobs of halteres dark brown; legs elongate; femora obscure yellow, with a narrow black ring before tip and a more diffuse darkened annulus at near two-thirds the length of the segment; wings yellow, with a heavy, tessellated, brown pattern; stigma pale brown, ringed with dark brown; Sc long; Rs angulated on basal third; R_{1+2} unusually long, exceeding R_{2+3}; inner end of cell 1st M_2 arcuated; m-cu before fork of M; abdomen chiefly yellow, the subterminal segments blackened; male hypopygium with a single dististyle that

is pale, narrowed to the subacute tip; cerci simple, elongate, and very slender.

Male.—Length, about 12 millimeters; wing, 12.

Female.—Length, about 13 to 14 millimeters; wing, 12 to 13.5.

Rostrum and palpi black. Antennæ with scape brownish yellow; pedicel yellow; basal flagellar segments obscure yellow, the outer ones passing into brown; flagellar segments cylindrical, with long conspicuous verticils that much exceed the segments in length, the longest of these being unilaterally arranged, one to each segment; terminal segment elongate, about one-half longer than the penultimate. Head brown, somewhat paler on occiput; anterior vertex and front black, sparsely pruinose, the former (male) reduced to a linear strip.

Pronotum yellow, narrowly dark brown medially. Mesonotal præscutum yellow, with three brownish black stripes, the median one not attaining the cephalic border of the sclerite nor the suture behind; lateral stripes with their anterior ends bent laterad to margin, the posterior ends not reaching suture; scutum with lobes extensively blackened, this color produced laterad along the suture, median area pale; scutellum pale medially at base, the posterior border margined with brown; mediotergite dark brown, the lateral margins pale. Pleura yellow, weakly darkened on ventral sternopleurite and ventral pleurotergite, and, in certain cases, along the cephalic border of the pteropleurite; a more intensely colored but small spot beneath wing root; dorsopleural membrane faintly dusky. Halteres relatively long, yellow, the knobs dark brown. Legs long and slender; coxæ yellow, the outer faces of fore and middle coxæ weakly darkened; trochanters yellow; femora yellow, more obscure brownish yellow on basal two-thirds, the distal third clearer yellow, with a narrow black subterminal ring about its own length before tip; a second, usually wider but more diffuse, femoral annulus immediately preceding the yellow subterminal ring; tibiæ brownish yellow, the tip narrowly darker; tarsi black; claws (male) with three basal teeth, the outer one larger. Wings (Plate 1, fig. 11) yellow, with a tessellated dark brown pattern that appears as linear streaks in centers of anterior cells and a heavier, more extensive, chiefly marginal pattern in the cells of posterior half of wing; cells C and Sc uniformly light yellow, scarcely variegated by darker; prearcular field brownish yellow; stigma elongate, pale brown, ringed with dark brown; cord, outer end of cell 1st M_2, and tip of vein Sc narrowly seamed with

darker brown; veins brown, yellow in the flavous costal portions. Venation: Sc long, Sc_1 ending shortly before fork of Rs, Sc_2 longer, oblique in position, its distal end about opposite this fork; Rs angularly bent on basal third; R_{1+2} of unusual length, exceeding vein R_{2+3} and subequal to or longer than vein Sc_2+R_1; basal section of R_{4+5} strongly arcuated to angulated and spurred at near midlength; inner end of cell 1st M_2 strongly arcuated, lying about on a level with cell R_3; m-cu before fork of M; cell 2d A relatively narrow.

Abdomen with basal segments yellow, the pleural region and caudal borders very narrowly darkened; subterminal segments black; hypopygium yellow; in the female the basal abdominal segments more brownish yellow. Male hypopygium (Plate 3, fig. 34) with apical margin of tergite, *9t*, notched. Dististyle, *d*, pale, curved to the subacute tip. Gonapophyses, *g*, with short apical point. Ædeagus, *a*, narrowed to the bilobed apex. Ovipositor with cerci long and very slender, the tips acute.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*). Allotopotype, female. Paratopotype, female.

The present fly is most generally similar to *Limonia* (*Limonia*) *cranbrooki* Edwards, differing in the body coloration, uniformly darkened knobs of halteres, leg and wing pattern, and details of venation, as the usually long R_{1+2} and the smaller cell 1st M_2.

LIMONIA (DISCOBOLA) TAIVANELLA Alexander.

Limonia (*Discobola*) *taivanella* ALEXANDER, Philip. Journn. Sci. 43 (1930) 511–512.

Described from the high mountains of Formosa. A small series, including both sexes, was taken at light at White Cloud Temple, Mount Omei, Szechwan, western China, altitude 9,000 feet, July 29, 1935, by Franck.

LIMONIA (DICRANOMYIA) STERNOLOBATA sp. nov. Plate 1, fig. 12; Plate 3, fig. 35.

Size large (wing, male, over 9 millimeters); general coloration gray; rostrum, palpi, and antennæ black throughout; femora black, the bases narrowly yellow; wings handsomely tinted with pale yellow, the prearcular cells bright yellow; a sparse darker wing pattern, including a weak suffusion in outer radial field; basal abdominal segments yellow, the outer ones black; male hypopygium with each basistyle produced ventrad and caudad into a long fingerlike lobe.

Male.—Length, about 10 millimeters; wing, 9.2.

Female.—Length, about 10 millimeters; wing, 10.

Rostrum and palpi black. Antennæ black throughout; flagellar segments short-oval, beyond the fourth or fifth flagellar becoming more elongate; basal four or five flagellar segments with very short apical pedicels, the succeeding segments sessile; verticils longer than the segments, except on the outer ones; terminal segment about one-third longer than the penultimate. Head dark gray, clearer gray on front and anterior vertex, more grayish brown behind; anterior vertex (male) relatively wide, about equal to twice the diameter of scape.

Pronotum black. Mesonotum dark gray, the præscutum with a single, conspicuous, subnitidous black, median stripe that does not reach the suture behind. Pleura heavily gray pruinose, the dorsopleural membrane brown. Halteres short, the base of stem yellow, the remainder dusky, the knobs blackened. Legs with the coxæ obscure brownish yellow; trochanters yellow; femora black, only the narrow bases yellow; tibiæ a little paler, brownish black, the bases narrowly, the tips more broadly, blackened; tarsi black; claws only slightly curved, with two basal teeth, the outermost larger. Wings (Plate 1, fig. 12) handsomely tinted with very pale yellow, the prearcular cells clear bright yellow; cell Sc dark brown; stigma short-oval, dark brown, confluent with a very narrow dark seam on cord; vein Cu and outer end of cell 1st M_2 seamed with darker; cells R_2 to M_2, inclusive, weakly suffused with brown; axilla feebly darkened; veins black, the prearcular field and vein Sc_2+R_1 before stigma light yellow. Venation: Sc short, Sc_1 ending opposite or immediately before origin of Rs, Sc_2 some distance back from tip; free tip of Sc_2 short, a little proximad of the long R_2, vein R_1 thus reduced to a short element; m-cu at or just before fork of M; vein 2d A long.

Basal six abdominal segments yellow, the succeeding segments, including most of the hypopygium, black; ventral dististyle yellow. Male hypopygium (Plate 3, fig. 35) very large and complicated, chiefly by outgrowths of the basistyle. Basistyle, *b*, produced ventrad and caudad into long, dark, fingerlike lobes; near proximal end a small lobe, fringed at apex with wavy setæ; at near midlength beyond this point the lobe is slightly bent, at point of angulation with a dense tuft of very long delicate setæ. Dorsal dististyle small and slender, entirely superimposed over the ventral style; near base bent at a right angle. Ventral

dististyle, *vd,* relatively small, the rostral prolongation very broad, its outer apical angle produced into a spinous point; rostral spines two, placed close together at base of this point; ventral margin of lower lobe of prolongation with a dense fringe of yellow setæ; from extreme base of style a tuft of very long slender setæ; mesal face of fleshy lobe of style, at base of prolongation, with a dense group of setæ. Gonapophyses, *g,* with the mesal-apical angle produced into a slender, gently curved, black spine. Ædeagus, *a,* sinuous, slender, dusky in color.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Allotopotype, female.

This striking species adds still another member to the subgenus *Dicranomyia* having an enlarged and complicated male hypopygium. From other regional allies in eastern Asia, as *Limonia* (*Dicranomyia*) *bifusifera* (Edwards), *L.* (*D.*) *grahamiana* Alexander, *L.* (*D.*) *megacauda* (Alexander), *L.* (*D.*) *platyrostra* (Alexander), and *L.* (*D.*) *veternosa* Alexander, the present fly is amply distinguished by the large size and by the structure of the male hypopygium. The male sex of *L.* (*D.*) *transfuga* Alexander, of Kashmir, is still unknown, but the fly is entirely different in coloration from the present insect.

HEXATOMINI

ADELPHOMYIA (ADELPHOMYIA) CERINA sp. nov. Plate 1, fig. 13; Plate 3, fig. 36.

General coloration of thorax pale wax yellow; antennæ 16-segmented, black beyond the scape; wings narrow, hyaline, the stigma insensibly darker; macrotrichia of wing cells reduced to a minimum in outer end of cell R_4; Rs elongate; abdomen pale brown, darker subterminally; male hypopygium with dististyles subterminal, the apex of basistyle produced into an acute spine.

Male.—Length, about 3.5 millimeters; wing, 4 by 1.2.

Rostrum pale yellow; palpi darker. Antennæ 16-segmented; basal segment pale, the pedicel and flagellum black; pedicel enlarged; basal flagellar segments more or less bulging on lower face, beyond the fourth passing through oval to elongate; verticils exceeding the segments in length. Head pale brownish yellow.

Mesonotum and pleura entirely wax yellow, the surface more or less nitidous. Halteres relatively elongate, pale. Legs with the coxæ and trochanters yellow; remainder of legs broken.

Wings (Plate 1, fig. 13) narrow, as shown by the measurements; hyaline, the stigma insensibly darker; veins brownish yellow, a little darker colored than the ground; macrotrichia black. Macrotrichia of cells reduced to a minimum of about three in distal end of cell R_4 (indicated in figure by stippled dots). Venation: Sc_1 ending shortly before fork of the long, gently arcuated Rs; R_{2+3+4} about twice R_2, the latter subequal to R_{2+3}; cell M_1 present; m-cu at near midlength of cell 1st M_2; vein 2d A long, ending nearly opposite the origin of Rs.

Abdomen pale brown, darker subterminally; hypopygium obscure yellow. Male hypopygium (Plate 3, fig. 36) with the dististyles subterminal in position, the basistyle, *b*, produced caudad beyond the point of their insertion into an acute pale spine; setæ of basistyle very large and coarse on outer half or less. Outer dististyle, *od*, slender, terminating in two acute spines, the apical one a little longer and more curved; before apex on lower edge with four or five microscopic denticles. Inner dististyle, *id*, dilated at base, the surface with abundant setulæ and a few coarse setæ, the narrowly obtuse apex more glabrous. Basal gonapophyses, *g*, appearing as very slender, straight spines.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

The present species is readily told from allied regional forms by the narrow hyaline wings, with the macrotrichia of the cells unusually reduced in number. The nearest described ally is *Adelphomyia* (*Adelphomyia*) *nipponensis* Alexander, which differs in the coloration of the body and wings, abundant macrotrichia of the outer cells of wing, and details of structure of the male hypopygium.

PHYLLOLABIS LAUDATA sp. nov. Plate 1, fig. 14; Plate 3, fig. 37.

General coloration of mesonotum testaceous-brown, the mediotergite and pleura dark brown; head brown, the anterior portions and orbits gray; legs obscure yellow; wings strongly suffused with brown, the stigma a little darker; R_{2+3+4} of moderate length, only a little more than one-third the length of Rs; M_{3+4} subequal to basal section of M_3; m-cu close to fork of M_{3+4}; male hypopygium with apical fleshy lobe of basistyle short.

Male.—Length, about 7.5 millimeters; wing, 8.5.

Rostrum brown; palpi black. Antennæ with scape and pedicel black, the flagellum paler, dark brown; flagellar segments cylindrical, the verticils shorter than the segments; terminal

segment a little shorter than the penultimate. Head with the front, anterior vertex, and posterior orbits gray, the posterior portion of head more infuscated; anterior vertex a little wider than the diameter of scape.

Pronotum dark brown. Mesonotal præscutum, scutum, and scutellum almost uniformly testaceous-brown, without distinct markings; mediotergite darker. Pleura uniformly dark brown, including the dorsopleural membrane. Halteres with the stem obscure yellow, the knobs infuscated. Legs with the coxæ brownish yellow, the fore pair a little darker; trochanters obscure yellow; remainder of legs obscure yellow, the outer tarsal segments a little darkened. Wings (Plate 1, fig. 14) strongly suffused with brown, almost uniformly distributed and without a distinct pattern other than the slightly darker, diffuse stigma; cell R, adjoining the outer end of vein M and the basal portions of cells 1st A and Cu slightly paler; veins brownish black, distinct against the ground. Macrotrichia of veins abundant, long and conspicuous. Venation: R_{2+3+4} of moderate length and arcuation, shorter than cell 1st M_2 and only a little more than one-third the length of Rs; M_{3+4} subequal to the basal section of M_3; m-cu close to the fork of M_{3+4}.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 3, fig. 37) massive and barrel-shaped, as in the genus; appendage of ninth sternite reduced to a narrow pale strip. Styli as shown, the darkened apical fleshy lobe of basistyle, *b*, less than one-half the length of the body of the style and shorter than the fleshy mesal lobe of latter. Outer blades of basistyle, *b*, simple at tips. Dististyle, *d*, with microscopic punctures at apex.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*).

Phyllolabis laudata is very distinct from the other Himalayan and western Chinese species of the genus, as *P. beesoni* Alexander, *P. confluenta* Alexander, *P. pictivena* Alexander, and *P. regelationis* Edwards. The uniformly colored wings, with unusually elongate Rs, and the structure of the male hypopygium readily separate the species from the above allied forms. I would consider *P. pictivena* to be its closest described relative, the species being readily told by the black coloration of the body, the conspicuously patterned wings, and the structure of the male hypopygium.

PHYLLOLABIS PICTIVENA Alexander. Plate 3, fig. 38.

Phyllolabis pictivena ALEXANDER, Philip. Journ. Sci. 49 (1932) 394.

The unique type, a female, was from the summit of Mount Omei, taken July 18, 1931, by Mr. Franck. The same collector secured a number, including both sexes, at the same place and altitude, July 30, 1935.

Allotype, male.—Length, about 8 millimeters; wing, 9.

Characters essentially as in the female, including the color of the legs, wings, and thorax. Male hypopygium (Plate 3, fig. 38) generally as in *laudata* sp. nov., and certain allied forms in the Nearctic fauna. Apical fleshy lobe, *b*, of basistyle very long, exceeding in length the body of style, about twice as long as the fleshy mesal lobe of the latter, and nearly equal in length to the bladelike extensions of the basistyle, *b*. The latter are apparently two in number, or at least deeply divided at apex so as to appear as two blades, in slide mounts superimposed; outer blade terminating in two, slender, chitinized points. Dististyle, *d*, not exceeding in length the shortest blade of the basistyle. Appendage of ninth sternite reduced to a linear pale strip.

PHYLLOLABIS VULPECULA sp. nov. Plate 1, fig. 15.

General coloration of mesonotum brown; legs black; wings with a strong fulvous-yellow tinge, the costal region and outer radial field deeply saturated with the same color; veins pale, poorly delimited against the ground; Rs a little longer than R_{2+3+4}; cell 1st M_2 elongate; m-cu just before fork of M_{3+4}; abdomen obscure brownish yellow, darker subterminally.

Female.—Length, about 7 millimeters; wing, 7.

Rostrum and palpi black. Antennæ pale brown throughout; flagellar segments oval, the terminal segments smaller. Head brownish gray.

Pronotum infuscated. Mesonotal præscutum and scutal lobes infuscated, the scutellum and mediotergite a trifle brighter. Pleura obscure yellow. Halteres weakly infuscated, the base of stem restrictedly pale. Legs with the coxæ and trochanters yellow; remainder of legs brownish black to black. Wings (Plate 1, fig. 15) with a strong fulvous-yellow tinge, the costal region and, especially, the outer radial field deeply saturated with the same color; stigma not different in color from the radial field; pale streaks in cell R adjoining the outer portion of vein M and in cell 1st A along the basal portion of the vein; veins pale, poorly defined against the ground. Venation: Sc_1

ending beyond midlength of R_{2+3+4}, Sc_2 pale, a short distance from the tip of Sc_1; Rs a little longer than R_{2+3+4}; cell 1st M_2 elongate, the second section of vein M_{1+2} exceeding two-thirds of the distal section; basal section of vein M_3 elongate, a little shorter than M_{3+4}; m-cu just before fork of M_{3+4}.

Abdomen obscure brownish yellow, darkened subterminally. Ovipositor with the cerci relatively strong, reddish horn-color, the margins smooth.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

Phyllolabis vulpecula is very different from the other species of the genus so far discovered in eastern Asia. The saturated fulvous wings, with unusually elongate cell 1st M_2, will suffice to separate the fly from all these allied forms (indicated under the account of *P. laudata* sp. nov.).

ERIOPTERINI

Genus FRANCKOMYIA novum

Antennæ (Plate 4, fig. 39, *at*) 12-segmented; pedicel not markedly enlarged; flagellum with a very long, basal, fusion segment, involving five segments, the fused element being equal in length to the succeeding five free segments; flagellar segments beyond the fusion cylindrical, the verticils subequal in length to the segments. Tibiæ spurless; claws simple. Wings (Plate 1, fig. 16) with Sc long, Sc_1 ending shortly before the fork of R_{2+3+4}, Sc_2 not far from its tip; R_3 suberect at base, weakly angulated at the narrowest point of cell R_1; no distinct R_2, its former position evidently indicated by the approximation of veins R_1 and R_{2+3}; a supernumerary crossvein in cell R_3 at near two-thirds the length, the cell somewhat constricted at point of insertion of the crossvein; cell M_1 present, subequal to its petiole; m-cu shortly beyond fork of M; vein 2d A of moderate length, ending shortly before level of origin of Rs. Male hypopygium (Plate 4, fig. 39) with the basistyle, *b*, of unusual length and slenderness, the distal end produced caudad beyond the point of insertion of the dististyle as a subquadrate pale flap that is provided with abundant setæ; near base of style on mesal face with a slender fingerlike lobe. Dististyle, *d*, bearing a gently curved blackened spine on outer margin before midlength; remainder of style narrowed to the pendant apex. Gonapophyses, *g*, blackened, narrowed at apex into a strong straight spine, the outer surface microscopically scabrous. Ædeagus, *a*, small.

Genotype.—*Franckomyia discalis* sp. nov. (Palæarctic Region: Western China).

I take great pleasure in naming this very interesting new group of crane flies in honor of Rev. Mr. George Meredith Franck, to whose serious efforts in collecting these flies we owe much of our present knowledge of the Tipulidæ of western China. This curious fly belongs to the subtribe Claduraria and is evidently most closely related to *Pterochionea* Alexander and *Crypteria* Bergroth. The greatest points of similarity to *Pterochionea* are found in the very elongate fusion segment of the flagellum and the single dististyle of the male hypopygium; to *Crypteria,* a relationship is indicated by the upward swing of vein R_{2+3} near its base, narrowing cell R_1 at this point. Compared with *Pterochionea,* the condition of the fusion segment in the present fly is evidently more specialized, as there are no traces of incomplete sutures, indicating the former limits of the components of the fusion; the details of the hypopygium are very distinct in the two groups. Compared with *Crypteria,* the condition of the fusion segment is undoubtedly more generalized, being fully as elongate as the succeeding five segments of the flagellum; the hypopygium of *Crypteria* is very different, with two dististyles. The complete loss of vein R_2 in the present insect is presaged in certain specimens of *Crypteria* and allied groups, where the element tends to become evanescent. From both of the above-mentioned genera, as well as all other generic groups in the Claduraria, the present fly differs conspicuously in the strong supernumerary crossvein in cell R_3 of the wings.

FRANCKOMYIA DISCALIS sp. nov. Plate 1, fig. 16; Plate 4, fig. 39.

Mesothorax reddish yellow, unmarked; head dark gray; legs yellow, the femoral tips, tibial bases and tips, and outer tarsal segments darkened; wings nearly hyaline, with certain of the discal veins, including the cord and outer end of cell 1st M_2, darkened.

Male.—Length, about 4.8 to 5 millimeters; wing, 5.5 to 6.

Rostrum and palpi black. Antennæ black throughout, the structure (Plate 4, fig. 39, *at*) as described under the generic diagnosis. Head dark gray.

Pronotum infuscated. Mesothorax uniformly reddish yellow, without markings. Halteres uniformly pale. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly and gradually infuscated; tibiæ white, the bases and tips very narrowly and insensibly darkened, the amounts subequal; tarsi

with outer segments darkened; legs moderately hairy. Wings (Plate 1, fig. 16) nearly hyaline, with a restricted brown discal pattern, appearing chiefly as a darkening of the veins, as follows: Cord; outer end of cell 1st M_2; supernumerary crossvein in cell R_3; fork of M_{1+2}; outer section of vein M_3; veins pale, except as indicated above. Venation as discussed under the genus.

Abdominal tergites brownish black, the basal sternites paler, the outer sternites dark, sparsely pruinose; styli brown. Male hypopygium (Plate 4, fig. 39) as discussed under the genus.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, at light, July 30, 1935 (*Franck*). Paratopotype, male.

Franckomyia discalis is very different in its general appearance from all other described members of the subtribe Claduraria in eastern Asia. Superficially, the fly resembles more closely a species of the genus *Dicranota* (*Amalopina*), as *dicranotoides* (Alexander), than it does any other crane fly.

TRENTEPOHLIA (MONGOMA) ENERVATA sp. nov. Plate 1, fig. 17.

General coloration of body dark brown, the median area of scutum and the scutellum testaceous-yellow; legs dark brown, the tips of all tibiæ narrowly whitened; all tarsi white; wings with a strong dusky tinge; Rs shorter than the gently sinuous R_{2+3+4}; cell 1st M_2 relatively short and broad; m-cu just before fork of M; abdomen dark brown.

Female.—Length, about 7 millimeters; wing, 6.2.

Rostrum black, palpi paling to yellow. Antennæ black throughout; flagellar segments cylindrical, the longest verticils subequal to or a trifle shorter than the segments; terminal segment elongate. Head brownish black.

Pronotum brownish black. Mesonotum dark brown, the median area of scutum and the scutellum paling to testaceous-yellow. Pleura dark brown, the posterior sclerites, surrounding the root of halteres, a trifle paler. Halteres dusky, the extreme base of stem pale. Legs with the coxæ darkened, especially the fore pair which are almost black; trochanters obscure yellow; femora dark brown; tibiæ brown, a trifle paler outwardly, the tips narrowly but conspicuously white, including the setæ; amount of white on tibiæ subequal on all legs, involving approximately the distal tenth of the segment; tarsi white, the terminal segment scarcely darker; fore and middle femora with from six to eight small blackened spines at base; posterior tibiæ with

a long black terminal seta. Wings (Plate 1, fig. 17) with a strong dusky tinge, the prearcular and costal areas somewhat clearer; stigmal region small, infuscated; veins dark brown. The outer medial branches and distal half of R_4 pale and semi-evanescent; axillary margin of wing with three, long, powerful setæ. Venation: Sc_1 ending opposite the proximal end of vein R_2; Rs shorter than the gently sinuous R_{2+3+4}; veins R_3 and R_4 diverging; cell 1st M_2 relatively small, its greatest width exceeding one-half the length; inner end of cell 2d M_2 lying shortly more distad than the subequal cells R_5 and M_3; m-cu shortly before fork of M; distal fusion of Cu_1 and 1st A slight.

Abdomen dark brown, the cerci and hypovalvæ horn yellow.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Shin Kai Si Temple, altitude about 4,000 feet, at light, August 4, 1935 (*Franck*).

Trentepohlia (*Mongoma*) *enervata* is very different from the other regional species of the subgenus in the conspicuously whitened tips of all the tibiæ, in conjunction with the uniformly darkened femora and the white tarsi. The nearest regional ally is *T.* (*M.*) *montina* Alexander (Formosa), which differs especially in the coloration of the legs and in the details of venation. Another species *T.* (*M.*) *choprai* Alexander (western Himalayas), is likewise allied but with quite distinct venation.

GONOMYIA (PTILOSTENODES) AMICULA sp. nov. Plate 1, fig. 18; Plate 4, fig. 40.

General coloration black, only the scutellum obscure yellow; wings with a very faint brownish tinge; male hypopygium with the outer dististyle a flattened curved blade, at apex produced into two points.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments passing from oval to cylindrical; terminal segment longer than the penultimate; verticils a little exceeding the segments. Head dull black, sparsely pruinose.

Pronotum and mesonotum dull black, the scutellum obscure yellow. Pleura black, the surface of the posterior sclerites weakly pruinose. Halteres and legs black. Wings (Plate 1, fig. 18) with a very faint brownish tinge; veins black, very conspicuous. Venation: Sc_1 ending opposite origin of Rs, Sc_2 far from its tip, just beyond midlength of the vein; cell 2d M_2 small, about one-third its petiole; m-cu more than its own length before the fork of M.

Abdomen, including hypopygium, black. Male hypopygium (Plate 4, fig. 40) with the ventral lobe, *vb*, of basistyle clavate, with scattered setigerous punctures, with larger spinous setæ at apex. Outer dististyle, *od*, a flattened curved blade, produced at apex into two points, the lower one longer and more acute. Inner dististyle, *id*, much longer, at near two-thirds the length bearing a conspicuous, subappressed, flattened, black spine, the style beyond this point glabrous; basad of spine on inner face with abundant suberect setulæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

There are now four distinct species of the subgenus *Ptilostenodes* so far made known, these being *javanica* Alexander (Java), *ptilostenella* Alexander (Luzon), *ptilostenoides* Alexander (Formosa), and the present fly. The last species is separated from the previously described forms by the almost uniform black coloration of the body, antennæ, legs, and halteres, the other species having the body conspicuously variegated with yellow. The male sex of only a single species (*ptilostenella*) was previously known. The male of the present fly shows that excellent characters exist in the male hypopygium of members of the subgenus.

GONOMYIA (GONOMYIA) OCTOSPINOSA sp. nov. Plate 1, fig. 19; Plate 4, fig. 41.

Belongs to the *subcinerea* group; rostrum light yellow; antennæ black throughout; mesonotal præscutum, scutal lobes, and mediotergite chiefly grayish brown; legs black; wings tinged with brown, the prearcular and costal regions clear light yellow; Sc long, Sc_1 ending about opposite one-third the length of Rs; m-cu shortly beyond the fork of M; male hypopygium with each inner dististyle bearing three black spines; phallosome subtended by two black spines.

Male.—Length, about 5 millimeters; wing, 5.8.

Rostrum light yellow; palpi black. Antennæ black throughout; outer flagellar segments becoming very thin and attenuated. Head grayish brown.

Mesonotal præscutum almost covered by a grayish brown shield, composed of entirely confluent præscutal stripes, the humeral region yellow; median region of scutum and posterior portions of scutal lobes yellow, the centers of the lobes grayish brown; scutellum yellow, the parascutella a trifle more obscure;

mediotergite dark brown, each anterolateral angle restrictedly yellow. Pleura somewhat crushed in the unique type but apparently clear light yellow throughout. Halteres with the stem pale yellow, the knobs weakly infuscated. Legs with the coxæ and trochanters yellow; remainder of legs brownish black. Wings (Plate 1, fig. 19) with a brownish tinge, the prearcular and costal regions clear light yellow; stigmal region very vaguely darkened; veins brown, luteous in the yellow areas. Venation: Sc relatively long, Sc_1 ending about opposite one-third the length of Rs, Sc_2 subobsolete, near tip of Sc_1; R_{2+3+4} elongate, only a little shorter than Rs; m-cu about one-third its length beyond the fork of M.

Abdominal tergites dark brown, the sternites yellow. Male hypopygium (Plate 4, fig. 41) with the apical lobe of basistyle, *b*, less than one-third the long fleshy outer dististyle, *od*. Inner dististyle, *id*, with three black spines, the more basal one on outer margin slender and straight, bearing a powerful seta at its base; outer spine long and flattened; a broad-based discal spine about intermediate in length between the two marginal ones. Phallosome, *p*, with two long, slender, blackened spines, arising near base of ædeagus, *a*.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

Gonomyia (*Gonomyia*) *octospinosa* is quite distinct from the other regional species of the genus in the unusual development of spines on the male hypopygium, there being a total of eight, with three on each inner dististyle and two subtending the phallosome.

ERIOPTERA (ILISIA) POSTREMA sp. nov. Plate 1, fig. 20.

Belongs to the *areolata* group; size large (wing, female, 5.4 millimeters); general coloration of head and thorax gray; halteres pale yellow; legs brownish black; wings almost uniformly cream-yellow, the stigma elongate, pale brown; veins yellow, poorly delimited against the ground; Sc_2 only a short distance beyond the origin of Rs; cell 2d A narrow; abdomen black.

Female.—Length, about 5 millimeters; wing, 5.4.

Rostrum and palpi black. Antennæ dark brown throughout; flagellar segments truncated oval, the verticils exceeding the segments; terminal segment a little more than one-half the penultimate. Head blackish, pruinose.

Anterior lateral pretergites very obscure yellow. Mesonotum gray, the præscutum with extremely vague indications of darker stripes; pseudosutural foveæ and tuberculate pits dark brown. Pleura dark gray throughout. Halteres pale yellow. Legs with the coxæ dark brown; trochanters yellowish brown; remainder of legs brownish black. Wings (Plate 1, fig. 20) almost uniformly cream-yellow, the prearcular and costal areas clearer light yellow; stigma elongate, pale brown; veins yellow, poorly delimited against the ground; no darkening of veins along cord, as in *subareolata;* macrotrichia pale brown. Venation: Sc_1 ending shortly beyond R_2, Sc_2 less than twice its own length beyond origin of Rs; cell 1st M_2 small, as in the group; veins M_3, M_4, and Cu_1 strongly upcurved at tips; vein 2d A nearly straight.

Abdomen black, the elongate valves of ovipositor dark horn-color; bases of hypovalvæ and the genital segment blackened.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

In its dark gray thoracic color, with black legs and abdomen, the present fly differs notably from all its allies in eastern Asia. Compared with *Erioptera* (*Ilisia*) *subareolata* Alexander, likewise from western China, the present fly is readily told by the gray thorax and blackened legs.

ORMOSIA LATAURATA sp. nov. Plate 1, fig. 21; Plate 4, fig. 42.

Belongs to the *nigripila* group; general coloration black, the præscutum reddish brown; antennæ yellow, the bases of the flagellar segments narrowly infuscated; legs of male with basal half of femora black, the outer half golden yellow, tibiæ and basitarsi yellow; legs of female black, the extreme tips of femora and bases of tibiæ pale yellow; wings dark brown, abundantly dotted and spotted with white; male hypopygium with the outer arm of dististyle very long and slender; longest gonapophysis a slender, gently curved spine, gradually narrowed to the acute tip.

Male.—Length, about 3.5 to 3.7 millimeters; wing, 4.3 to 4.4.

Female.—Length, about 4.5 millimeters; wing, 4.5.

Male.—Rostrum and palpi black. Antennæ relatively long, if bent backward extending to near middistance between roots of wings and halteres; antennæ yellow, the bases of the flagellar segment narrowly darkened, the amount of the latter color in-

creasing on the outer segments; flagellar segments elongate, with very long verticils at near midlength of the segments, these unilaterally arranged, together with a dense, erect, pale pubescence. Head brownish black.

Pronotum dark brown. Mesonotal præscutum rich reddish brown, without evident markings; posterior sclerites of mesonotum black, sparsely pruinose. Pleura black, sparsely pruinose. Halteres pale yellow, the stem slightly darkened at outer end, the knob golden yellow. Legs with the coxæ and trochanters black; femora black on basal half, the distal half or slightly less golden yellow, including the setæ, the proportion of yellow to black being slightly less on posterior legs where about two-fifths of the segment is brightened; tibiæ and basitarsi yellow, the outer tarsal segments brownish black. Wings (Plate 1, fig. 21) dark brown, abundantly dotted and spotted with white, all such spots being relatively small; larger white areas include the origin of Rs, Sc_2, Sc_1, and R_2; along cord and outer end of cell 1st M_2; marginal spots at R_{1+2}, R_3, R_4, and 1st A, the remaining marginal spots small; lesser markings include white droplets in outer radial field and in most of the cells basad of the cord, these areas variable in number and position; costal pale areas somewhat more yellowish white; veins dark, white and almost obliterated in the pale areas. Trichia of cells black, weaker and pale yellow in the white areas. Venation: Cell 1st M_2 closed; m-cu sinuous, shortly before fork of M; anal veins divergent.

Abdomen, including hypopygium, black. Male hypopygium (Plate 4, fig. 42) of the general structure of the group, but the outer lobe of the outer dististyle, *od,* of unusual length and slenderness. Inner dististyle, *id,* likewise unusually long and narrow, with four long setæ, beginning at the weakly angulated middle portion of the style, the outer seta placed on face of style remote from margin. Longest gonapophyses, *g,* appearing as long, very slender, acute spines that are gently curved.

Female.—Generally as in male. Antennæ shorter but similarly bicolorous. Femora and tibiæ black, only the extreme tip of the former and base of the latter pale yellow; tarsi black.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Nwa Nien Pin Temple, altitude 6,500 feet, July 31, 1935 (*Franck*). Allotopotype, female, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, July 27, 1935. Paratopotypes, 2 males, with the type; 1 male with the allotype.

Ormosia lataurata and the species next described as *O. angustaurata* sp. nov. are among the most beautiful and distinct species of the genus so far made known. There is no closely related species so far described, but the two forms themselves are closely allied, differing most evidently in the antennal and leg coloration, wing pattern, and structure of the male hypopygium.

ORMOSIA ANGUSTAURATA sp. nov. Plate 4, fig. 43.

Male.—Length, 4 to 4.5 millimeters; wing, 4.7 to 5.

Female.—Length, about 4 millimeters; wing, 4.5.

Closely allied to *O. lataurata* sp. nov., differing as follows:

Male.—Antennæ with basal segments yellow, those of outer half passing into dark brown, the individual segments not bicolorous, as in *lataurata*. Mesonotum somewhat darker, more infuscated. Legs with the femora black, the tips narrowly yellow; tibiæ obscure yellow; basitarsi obscure yellow, the tips narrowly darkened; remaining tarsal segments infuscated. Wings pale brown, with a conspicuous white pattern, the general arrangement much as in *lataurata*, but the areas larger and restricted to the vicinity of the veins; small droplets of *lataurata* lacking or greatly restricted in number; white areas at ends of anal veins large and conspicuous. In the holotype the pale costal areas at origin of Rs, Sc_2, and Sc_1 are very large, reaching the costal border. Male hypopygium (Plate 4, fig. 43) much as in *lataurata*, especially as regards the outer dististyle, *od*. Inner dististyle, *id*, with five elongate setæ, the more basal near upper margin of style, the outermost close to the ventral edge. Gonapophyses, *g*, of entirely different structure from those of *lataurata*, the chief pair appearing about as illustrated.

Female.—Generally as in male, differing in the sexual characters. Tibiæ and tarsi dark brown or brownish black, a little paler than the femora.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female. Paratopotypes, 2 males.

The two species of the *nigripila* group of *Ormosia* herewith described as *O. lataurata* and *O. angustaurata* bear a surprising superficial resemblance to various members of the subgenus *Mesocyphona* of the genus *Erioptera* in the Nearctic and Neotropical faunas, and to members of the *alboguttata* group of the typical subgenus *Erioptera* in eastern Asia.

ORMOSIA CURVISPINA sp. nov. Plate 1, fig. 22; Plate 4, fig. 44.

Belongs to the *similis* group; general coloration dull brownish black; antennæ (male) short; legs black; wings with a brown tinge; vein 2d A sinuous; abdomen, including hypopygium, black; male hypopygium with the inner arm of the outer pair of gonapophyses very strongly curved into a long black spine.

Male.—Length, about 3.8 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ (male) short, if bent backward ending at or a short distance before wing root, black throughout; flagellar segments oval, the verticils of the basal segments very long and conspicuous, the longest exceeding three times the length of the segment; beyond the fourth or fifth segments the verticils become shorter, on the outer ones being scarcely as long as the segments themselves. Head black.

Pronotum black, sparsely pruinose. Anterior lateral pretergites very restrictedly obscure yellow. Mesonotal præscutum dull brownish black, very sparsely pruinose, without markings; posterior sclerites of mesonotum brownish black. Pleura, including the dorsopleural region, dull black. Halteres with stem obscure, the knob light yellow. Legs with the coxæ brownish black; trochanters obscure yellow; remainder of legs black. Wings (Plate 1, fig. 22) with a brownish tinge, the stigmal region infuscated; veins brown, relatively stout; macrotrichia black. Trichia of the cells indicated in the figure by stippled dots. Venation: Sc_2 about opposite two-fifths the length of Rs; R_{2+3} about one-third R_2 alone; outer fork of M perpendicular at origin, not angulated at point of union of m and the distal section of vein M_3; m-cu close to fork of M; vein 2d A sinuous on the outer third or less.

Abdomen, including the hypopygium, black. Male hypopygium (Plate 4, fig. 44) with the ninth tergite, *9t,* having the lateral lobes rounded, the structure divided by a profound median split; outer face with very delicate setulæ arranged in elongate-oval areas. Inner dististyle, *id,* unusually deep, with a slender apical beak, the entire outer margin, including the crest, narrowly blackened. Outer gonapophyses, *og,* bifid, the outer arm a black spike that bears a small lateral spine at near two-thirds the length; inner arm a powerful, strongly curved, black spine, the tip acute. Inner gonapophyses, *ig,* an even longer, gently curved spine, much paler in color than the outer apophyses, the apex slender and acute.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*).

Ormosia curvispina is entirely different from all other regional species of the *similis* group. As is usually the case in this and most other genera in the Tipulidæ, the chief specific characters are to be found in the structure of the male hypopygium.

ORMOSIA SOLITA sp. nov. Plate 1, fig. 23; Plate 4, fig. 45.

Belongs to the *aculeata* group; general coloration of mesonotal præscutum reddish brown, without distinct markings; antennæ dark brown, in the male the intermediate flagellar segments with verticils of an unusual length; halteres yellow; legs yellow, the femora with a narrow, subterminal, brown ring; wings brownish gray, variegated by light and darker areas, including a conspicuous white area beyond stigma; cell R_3 of moderate length only, vein R_3 strongly upcurved at margin; vein 2d A with nearly the outer half sinuous.

Male.—Length, about 4 millimeters; wing, 4.8.

Female.—Length, about 4.5 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ of moderate length, dark brown throughout; flagellar segments subcylindrical, with unusually elongate verticils (male), on the intermediate segments these much exceeding the segments in length, on the outer segments becoming small and weak; terminal segment subequal in length to the penultimate. Head blackish gray, with yellow setæ.

Pronotum brown, the anterior lateral pretergites dirty white. Mesonotal præscutum reddish brown, without distinct markings, the interspaces with long yellow setæ; scutellum dusky; mediotergite and pleura blackish, the surface sparsely pruinose. Halteres yellow. Legs with the coxæ blackened; trochanters obscure yellow; femora yellow, with a narrow darkened subterminal ring that is subequal to or slightly more extensive than the yellow apex; indications of a second darkened ring, especially on forelegs, extensive but very diffuse and located nearer base of segment; tibiæ and tarsi yellow, the outer segments of the latter darkened. Wings (Plate 1, fig. 23) with a brownish gray tinge, sparsely variegated with darker, including the stigma and narrow seams along cord and outer fork of M; more whitish areas before cord and beyond stigma, the former crossing the cord into the base of cell M_3; outer end of cell M

less evidently darkened; surface of wing with abundant macrotrichia, these being black and coarser in the clouded patches, more delicate and pale yellow in the clear areas and elsewhere over the wing surface in scattered patches; costal fringe variegated with black and yellow setæ; veins brownish yellow, darker and narrowly seamed with dusky in certain regions of the wing. Macrotrichia of cells abundant (shown in figure by stippled dots). Venation: R_2 at or beyond fork of R_{3+4}; outer fork of M not angulated; m-cu conspicuously arcuated at near midlength; vein 2d A strongly sinuous, the arcuated portion occupying nearly one-half of the entire vein beyond arculus.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 4, fig. 45) with the tip of the basistyle, *b*, terminating in an acute sclerotized point. Dististyles subterminal in position, the inner one, *id*, strongly arcuated before midlength, the apex dilated into a head that terminates in an acute spine.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, at light, July 29, 1935 (*Franck*). Allotopotype, female, Nwa Nien Pin Temple, altitude 6,500 feet, July 31, 1935.

The other members of the *aculeata* group, as *aculeata* Alexander (Japan), *anthracopoda* Alexander (Formosa), *horiana* Alexander (Japan), and *lævistyla* Alexander (Japan), are all readily told by the different structure of the male hypopygia. The most similar regional species is *Ormosia auricosta* Alexander, of which the male sex is still unknown. The last species differs especially in the larger size and distinct features of venation and pattern of the wings, as the more extensively pale costa, the lack of a white poststigmal area, the presence of conspicuous marginal dark dots at ends of the longitudinal veins, and the feebly sinuous vein 2d A. It seems virtually certain that *auricosta* will likewise be found to belong to the *aculeata* group of the genus, although the somewhat similar *O. præcisa* Alexander is a member of the distinct *similis* group.

STYRINGOMYIA ANGUSTIPENNIS sp. nov. Plate 1, fig. 24.

General coloration medium brown; antennal flagellum yellow; femora obscure yellow, with two weak and diffuse brown rings; tibiæ with tips narrowly darkened and with a vague second ring at near basal third; wings narrow, especially near base, tinged with brownish yellow, unmarked; veins beyond costal area brown, contrasting against the ground; ovipositor with the longest valves blackened, glabrous, terminating in two long strong setæ.

Female.—Length, about 4 millimeters; wing, 4.5.

Rostrum and palpi brown. Antennæ with the scape brown, darker beneath; pedicel brownish yellow; flagellum yellow; flagellar segments oval, gradually decreasing in length outwardly. Head yellowish brown.

Mesonotum discolored in type, apparently medium brown, variegated by darker brown areas, especially on the posterior sclerites. Pleura crushed. Legs with the femora obscure yellow, weakly biannulate with pale brown, the subterminal ring narrower than the yellow apex, the postmedial ring very diffuse; tibiæ yellow, the tip narrowly infuscated, with very vague indications of a second annulus near basal third of segment; basitarsi yellow, the outer tarsal segments slightly darkened, especially apically, the terminal segment black. Wings (Plate 1, fig. 24) tinged with brownish yellow, unpatterned, the costal portion somewhat clearer yellow, especially the veins; veins beyond the costal portion brown, contrasting against the ground. Wings narrow, especially near base, best shown by narrowing of the cubital and anal cells. Venation: Cell 1st M_2 elongate, nearly equal in length to the longest veins beyond it; m-cu a little more than its own length beyond the fork of M; vein 2d A simple, the cell narrow.

Abdomen uniformly light brown. Ovipositor with the longest valves, apparently cerci, appearing as long blackened cones, the surface glabrous, at apex of each with two, long, powerful setæ that are a little longer than the valve itself; a further shorter seta on outer face near base.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,000 to 7,000 feet, at light, July 27, 1935 (*Franck*).

The nearest regional allies of the present fly are species such as *Styringomyia flava* Brunetti (southern India) and *S. taiwanensis* Alexander (Formosa), which have similarly unpatterned wings and simple vein 2d A. The present fly is well distinguished from the above and other generally similar regional forms by the brown veins that contrast strongly with the ground color of the unusually narrow wings.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *at*, antenna; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *ig*, inner gonapophysis; *od*, outer dististyle; *og*, outer gonapophysis; *p*, phallosome; *s*, sternite; *t*, tergite; *vb*, ventral lobe of basistyle; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Tipula* (*Trichotipula*) *longifimbriata* sp. nov.; venation.
2. *Tipula* (*Trichotipula*) *mallophora* sp. nov.; venation.
3. *Tipula* (*Schummelia*) *membranifera* sp. nov.; venation.
4. *Tipula* (*Schummelia*) *dissociata* sp. nov.; venation.
5. *Tipula* (*Acutipula*) *forticauda* sp. nov.; venation.
6. *Tipula* (*Acutipula*) *subintacta* sp. nov.; venation.
7. *Tipula* (*Vestiplex*) *avicularoides* sp. nov.; venation.
8. *Tipula* (*Oreomyza*) *prolongata* sp. nov.; venation.
9. *Stibadocerella omeiensis* sp. nov.; venation.
10. *Limonia* (*Limonia*) *omniflava* sp. nov.; venation.
11. *Limonia* (*Limonia*) *tessellatipennis* sp. nov.; venation.
12. *Limonia* (*Dicranomyia*) *sternolobata* sp. nov.; venation.
13. *Adelphomyia* (*Adelphomyia*) *cerina* sp. nov.; venation.
14. *Phyllolabis laudata* sp. nov.; venation.
15. *Phyllolabis vulpecula* sp. nov.; venation.
16. *Franckomyia discalis* sp. nov.; venation.
17. *Trentepohlia* (*Mongoma*) *enervata* sp. nov.; venation.
18. *Gonomyia* (*Ptilostenodes*) *amicula* sp. nov.; venation.
19. *Gonomyia* (*Gonomyia*) *octospinosa* sp. nov.; venation.
20. *Erioptera* (*Ilisia*) *postrema* sp. nov.; venation.
21. *Ormosia lataurata* sp. nov.; venation.
22. *Ormosia curvispina* sp. nov.; venation.
23. *Ormosia solita* sp. nov.; venation.
24. *Styringomyia angustipennis* sp. nov.; venation.

PLATE 2

FIG. 25. *Tipula* (*Trichotipula*) *longifimbriata* sp. nov.; male hypopygium, details.
26. *Tipula* (*Trichotipula*) *mallophora* sp. nov.; male hypopygium, details.
27. *Tipula* (*Schummelia*) *membranifera* sp. nov.; male hypopygium, details.
28. *Tipula* (*Schummelia*) *dissociata* sp. nov.; male hypopygium, details.
29. *Tipula* (*Acutipula*) *forticauda* sp. nov.; male hypopygium, details.
30. *Tipula* (*Acutipula*) *subintacta* sp. nov.; male hypopygium, details.

PLATE 3

FIG. 31. *Tipula* (*Vestiplex*) *avicularoides* sp. nov.; male hypopygium, details.
32. *Tipula* (*Oreomyza*) *prolongata* sp. nov.; male hypopygium, details.
33. *Limonia* (*Limonia*) *omniflava* sp. nov.; male hypopygium.
34. *Limonia* (*Limonia*) *tessellatipennis* sp. nov.; male hypopygium.
35. *Limonia* (*Dicranomyia*) *sternolobata* sp. nov.; male hypopygium.
36. *Adelphomyia* (*Adelphomyia*) *cerina* sp. nov.; male hypopygium.
37. *Phyllolabis laudata* sp. nov.; male hypopygium.
38. *Phyllolabis pictivena* Alexander; male hypopygium, details.

PLATE 4

FIG. 39. *Franckomyia discalis* sp. nov.; antenna, male hypopygium.
40. *Gonomyia* (*Ptilostenodes*) *amicula* sp. nov.; male hypopygium.
41. *Gonomyia* (*Gonomyia*) *octospinosa* sp. nov.; male hypopygium.
42. *Ormosia lataurata* sp. nov.; male hypopygium.
43. *Ormosia angustaurata* sp. nov.; male hypopygium.
44. *Ormosia curvispina* sp. nov.; male hypopygium.
45. *Ormosia solita* sp. nov.; male hypopygium.

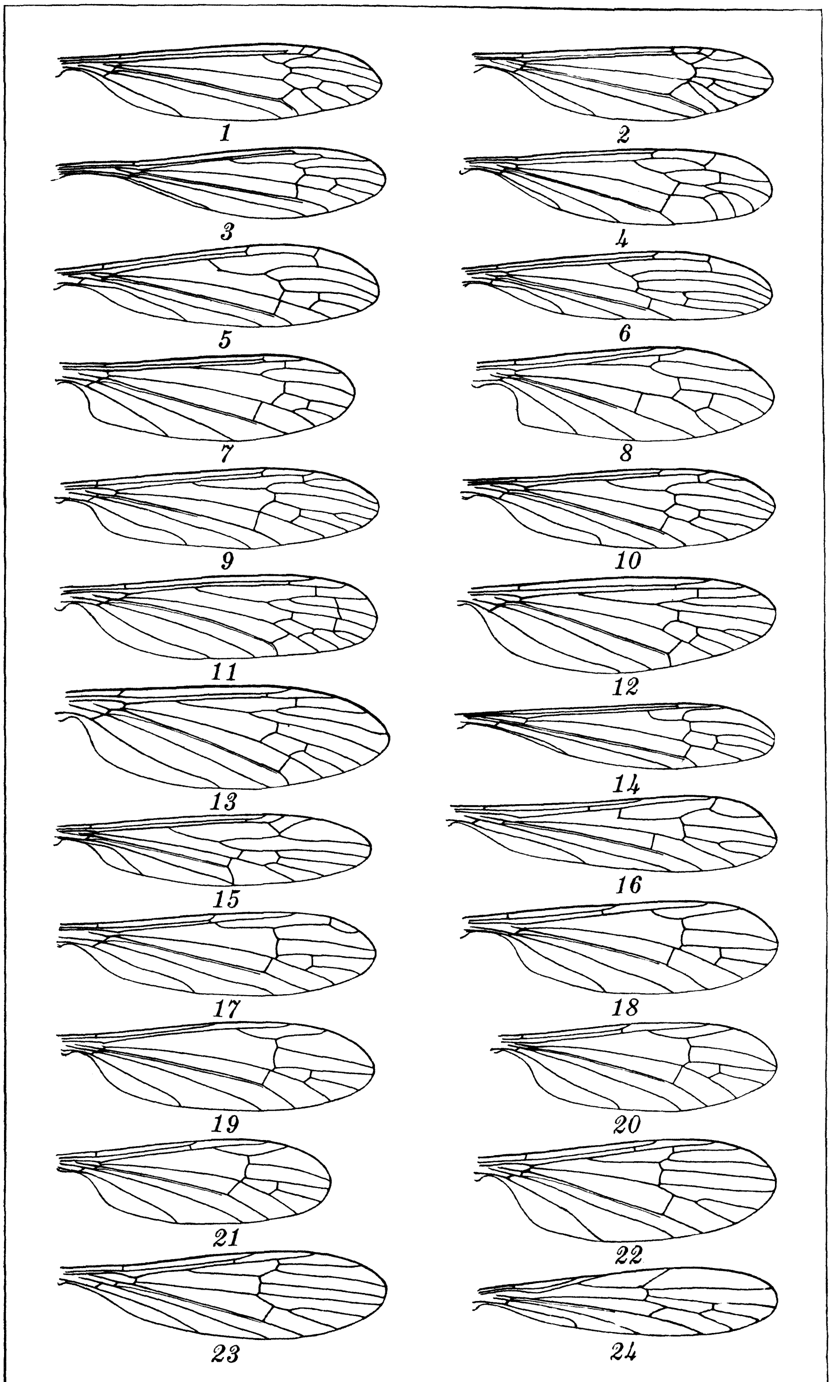

PLATE 1.

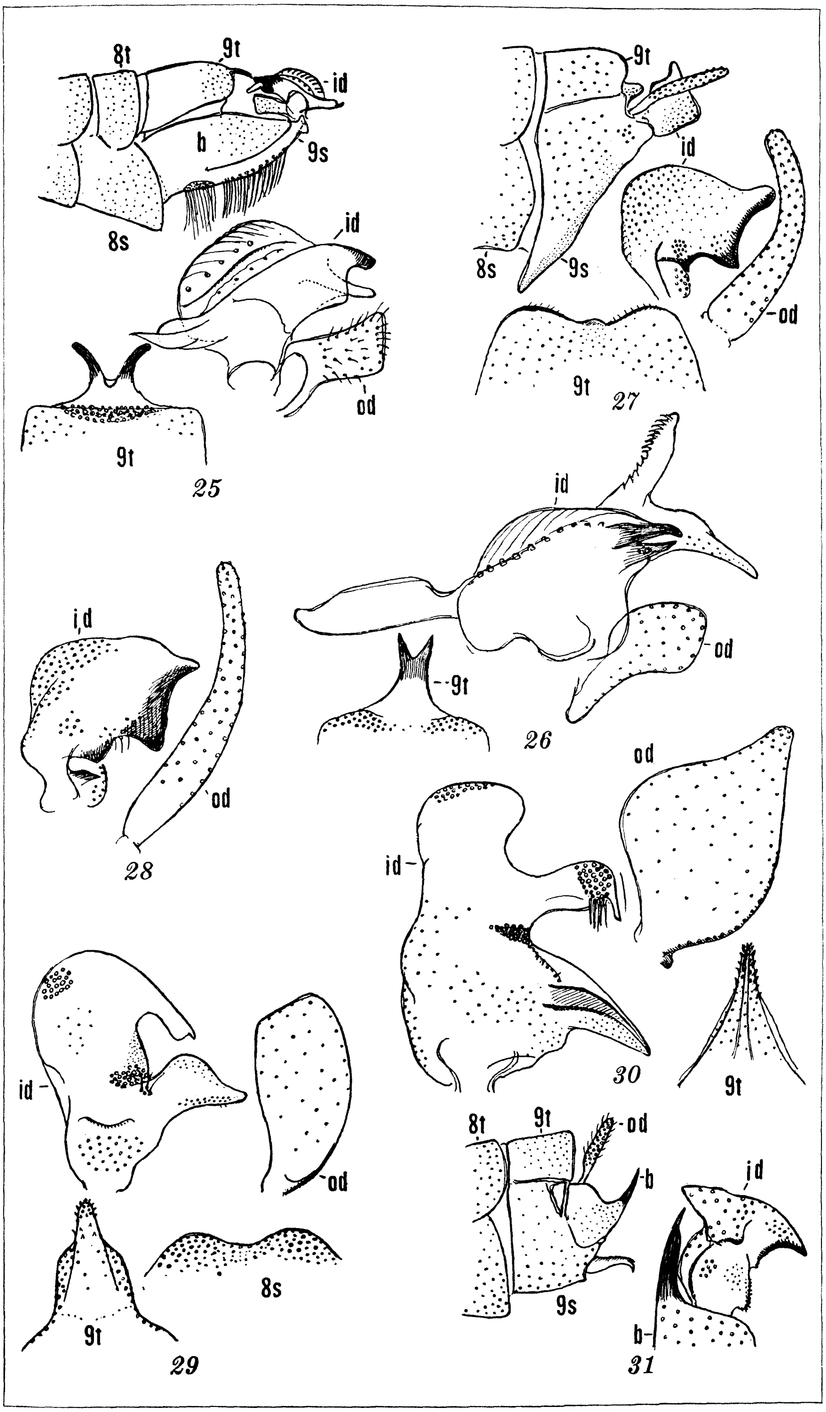
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PLATE 2.

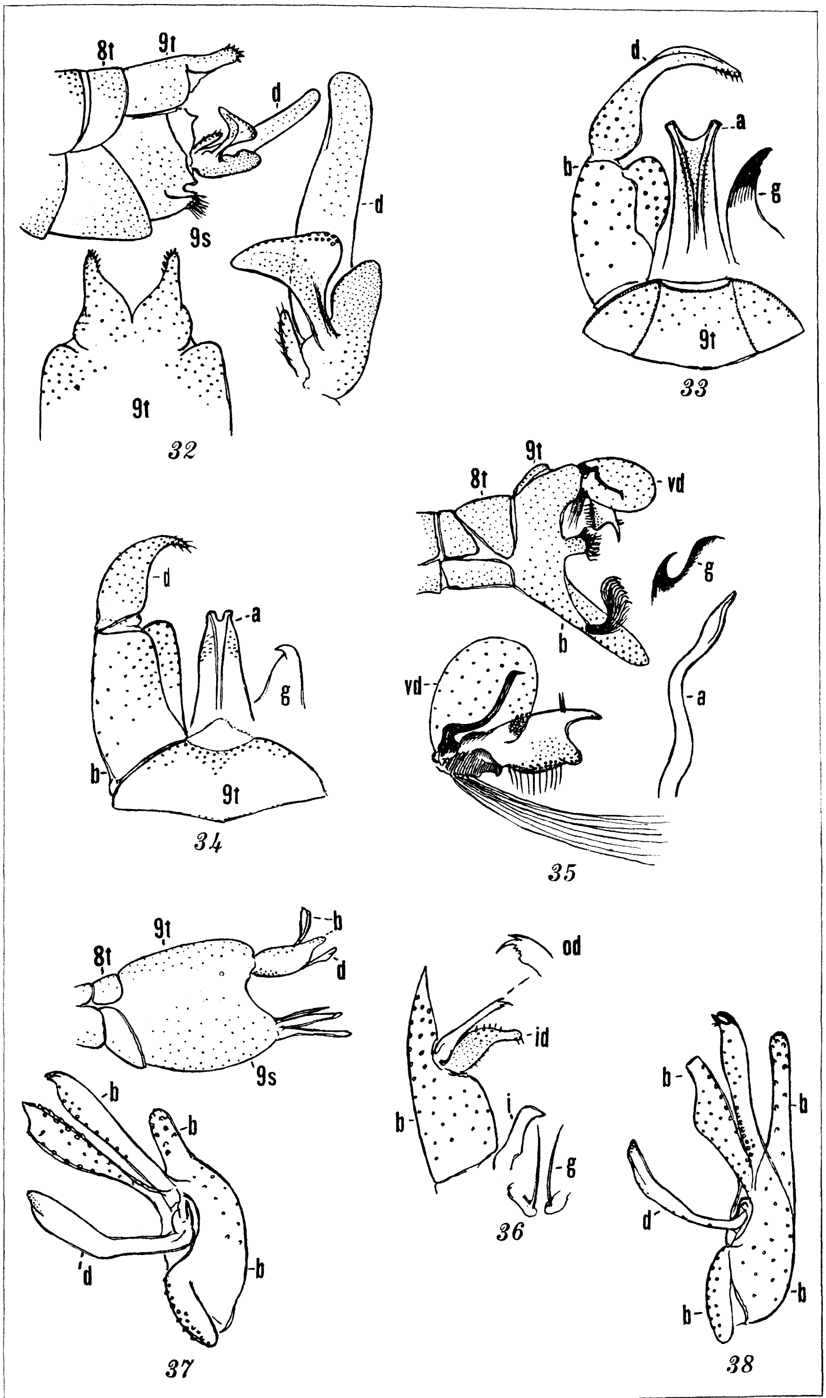
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PLATE 3.

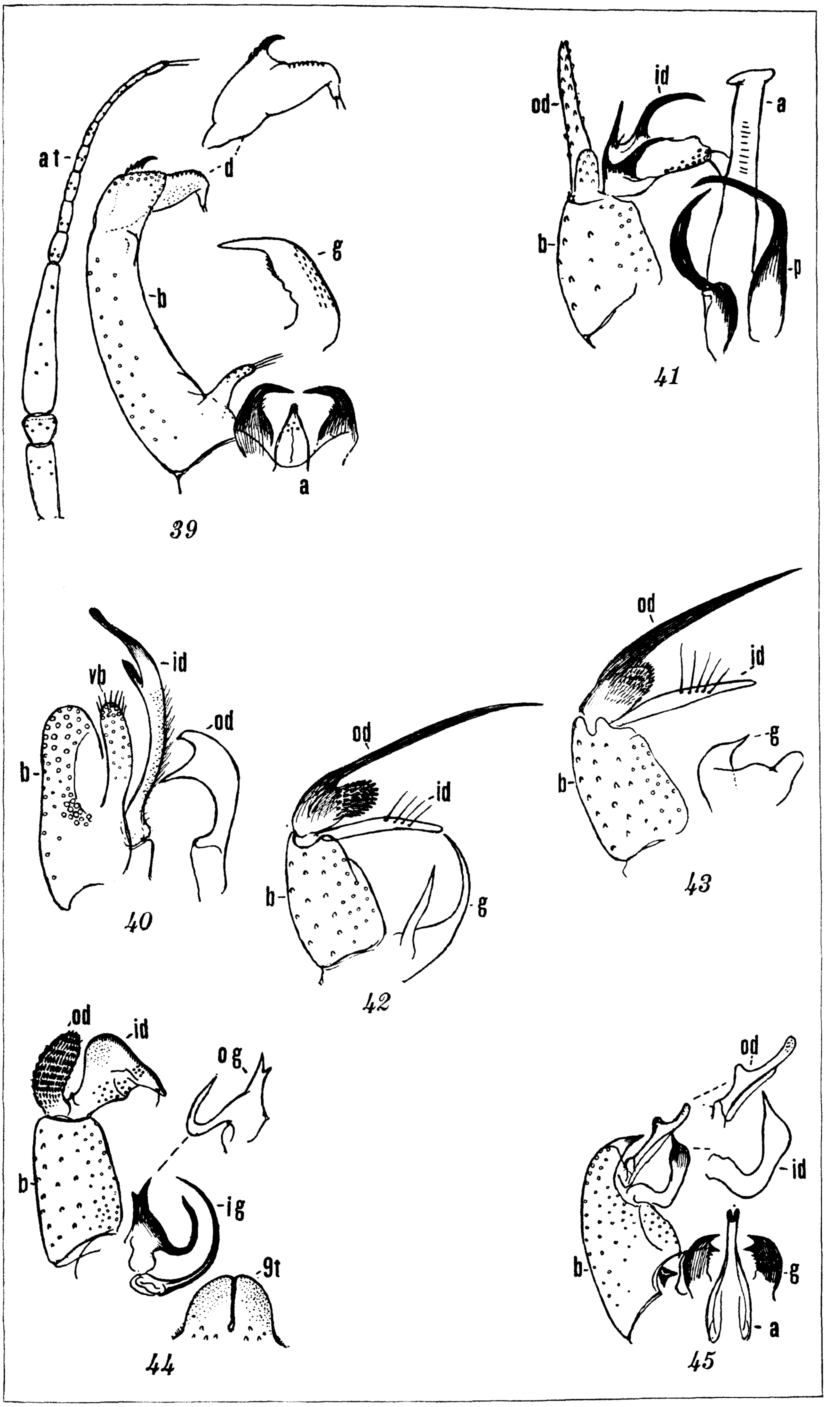
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PLATE 4.

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THE PHILIPPINE
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VOL. 60 AUGUST, 1936 No. 4

RINDERPEST STUDIES

By MANUEL M. ROBLES
Of the Bureau of Animal Industry, Manila

FIFTEEN TEXT FIGURES

I. ANTIRINDERPEST IMMUNE AND HYPERIMMUNE SERA

Ruediger (1910) and Hall (1933, cited by Bennett, 1934) both failed to notice any difference in the "titre" or protective value of "non-reactor" and "reactor" immune sera. But Ward and Wood (1912) demonstrated that the latter is more highly protective, as animals injected with it developed an average of 9.7 days of diagnostic symptoms plus febrile period as against 12.1 days among those given the nonreactor serum. On the other hand, Carmichael (1928) claims that nonreactor sera are useless.

Opinions are likewise at variance as to what factors determine the titer of a reactor immune serum. Edwards (1925) and Carmichael (1928) agree that such titer varies in direct relationship to the severity of the original reaction. On the contrary, Bennett (1934) claims that immune serum from cattle that have undergone a partially controlled attack of rinderpest "is of extremely variable potency; the potency, moreover, appears not to bear a constant relation either to severity of the symptoms or to the intensity of any particular symptom." In fact Kearney (1925, cited by Bennett, 1934) observed by parallel tests that serum from a beast that had given the lesser preliminary reaction gave better results. Topacio (1922) on the other hand showed that a febrile reaction of 39.5° to 40° C. and above for three or four consecutive days can produce a

reactor serum that he found to be as potent as the hyperimmune sera manufactured in the Philippines, the Pasteur Institute of Nathrang, and the laboratories of Harbin.

With regard to the effect of hyperimmunization, Edwards (1925) believes that "subsequent to the initial treatment of the serum producers there occurs what appears to be a maximum diffusion of the virus throughout the body which results in the development of such a state of immunity on the part of the tissues that the injection afterwards of the amounts of virus that are contained in massive quantities of virulent ox blood set up no more than a local disturbance quite incapable of evoking a tissue response sufficient to drive up the antibody content of the blood beyond the maximum titre attained following the preliminary treatment." Daubney (1928) appears to hold the same view. The work of Bennett (1934), however, demonstrates that "beasts providing immune serum of low potency will provide hyperimmune serum of high value after immunization." Rabagliati (1925) likewise proved that serum produced after Todd's method of hyperimmunization was more potent than the ordinary reactor serum.

Some of the controversial aspects of the subject of "immune and hyperimmune serums" are thus indicated. So with a view of shedding more light on these aspects, the following experiments were undertaken.

MATERIALS AND METHODS

NONREACTOR IMMUNE SERA

(1) *NR-3409.*—This was obtained from Fuga bull 3409 (fig. 1), which was vaccinated with 10 cc of glycerine-formolized rinderpest vaccine September 24, 1934; inoculated with 1 cc of fresh virulent blood October 10; developed no reaction thereafter; and finally was bled for serum November 5, 26 days after virus inoculation.

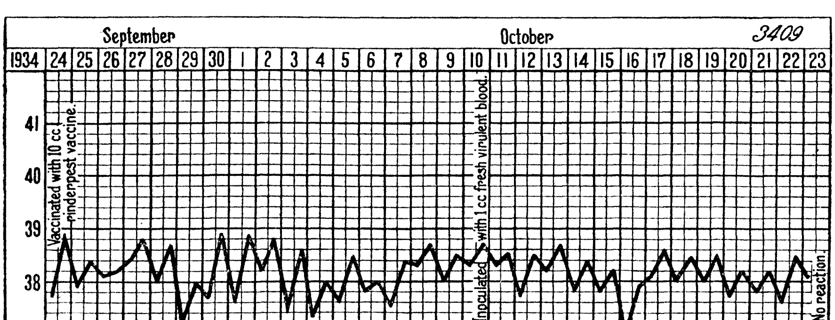

FIG. 1. Temperature chart of nonreactor serum producer 3409.

(2) *NR–3510.*—This was obtained from Fuga bull 3510, which was vaccinated with 0.5 g of dried rinderpest vaccine October 24, 1934; inoculated with 1 cc of fresh virulent blood November 7; developed no reaction thereafter; and finally was bled for serum November 29, 22 days after the virus inoculation.

(3) *NR–3680.*—This was obtained from Fuga bull 3680, which was vaccinated with 5 g of dried rinderpest vaccine October 23, 1935; inoculated with 0.5 cc of fresh virulent blood November 26; developed no reaction thereafter; and finally was bled for serum December 9, 14 days after virus inoculation.

(4) *NR–3684.*—This was obtained from Fuga bull 3684, which was vaccinated, reacted, and was bled in the same manner as NR–3680.

MILD REACTOR IMMUNE SERA

(1) *TR–3585.*—This was obtained from Fuga bull 3585 (fig. 2), which was simultaneously injected with 70 cc of antirinderpest immune serum and 2 cc of fresh virulent blood December 5, 1934; developed a low thermal reaction (below 40° C.) for 3 days; and finally was bled for serum December 27, 22 days after virus inoculation.

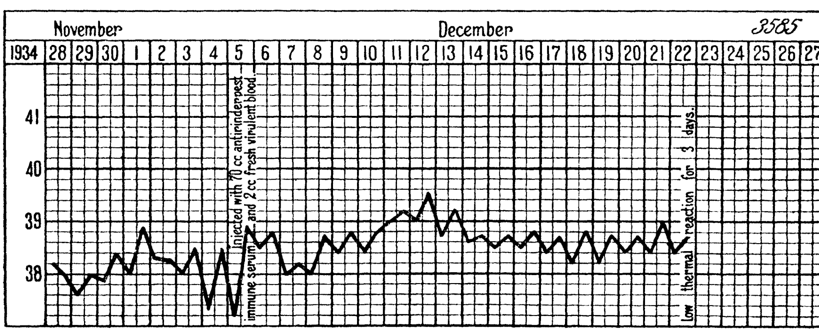

FIG. 2. Temperature chart of mild reactor serum producer 3585.

(2) *TR–3662.*—This was obtained from Tayabas bull 3662 (fig. 3), which was inoculated with 2 cc of fresh virulent blood July 30, 1935; developed a high thermal reaction (40° C. or over) for 3 days; and finally was bled for serum August 20, 21 days after virus inoculation.

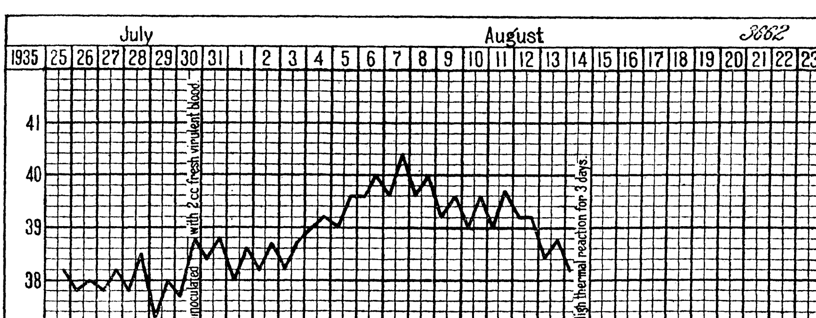

FIG. 3. Temperature chart of mild reactor serum producer 3662.

(3) *TR–3259.*—This was obtained from Fuga bull 3259 (fig. 4), which was vaccinated with 0.5 g of dried rinderpest vaccine September 19, 1934; inoculated with 1 cc of fresh virulent blood October 3; developed a high thermal reaction for 3 days; and finally was bled for serum November 5, 33 days after virus inoculation.

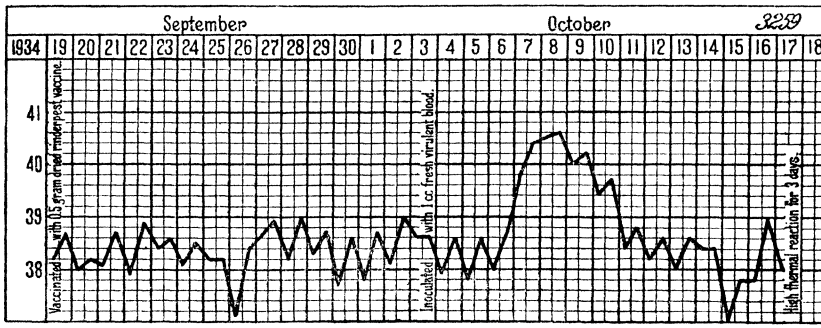

FIG. 4. Temperature chart of mild reactor serum producer 3259.

MARKED REACTOR IMMUNE SERA

(1) *TR–3566.*—This was obtained from Fuga bull 3566 (fig. 5), which was vaccinated with 0.5 g of dried rinderpest vaccine April 21, 1935; inoculated with 2 cc of fresh virulent blood May 7; developed a high thermal reaction for 4 days; and finally was bled for serum May 26, 19 days after virus inoculation.

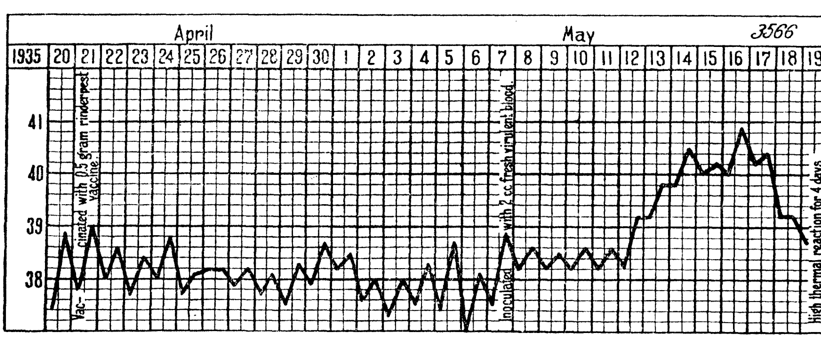

FIG. 5. Temperature chart of marked reactor serum producer 3566.

(2) *TR–3623.*—This was obtained from Fuga bull 3623, which was inoculated with 10 cc of fresh virulent blood August 7, 1934; developed a high thermal reaction for 5 days; and finally was bled for serum August 28, 21 days after virus inoculation.

(3) *TR–3660.*—This was obtained from Romblon bull 3660 (fig. 6), which was simultaneously injected with 19 cc of antirinderpest immune serum and 2 cc of fresh virulent blood July 30, 1935; developed a high thermal reaction for 6 days; and finally was bled for serum September 3, 35 days after virus inoculation.

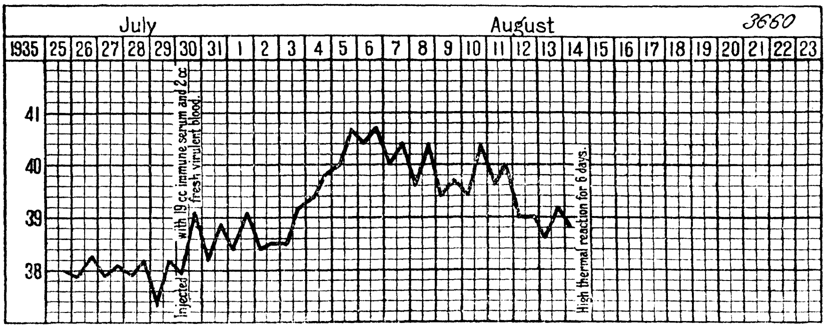

FIG. 6. Temperature chart of marked reactor serum producer 3660.

(4) *TR–3403.*—This was obtained from Fuga bull 3403, which was vaccinated with 10 cc of glycerine-formolized rinderpest vaccine September 27, 1934; inoculated with 1 cc of fresh virulent blood October 10; developed a high thermal reaction for 6 days; and finally was bled for serum November 1, 22 days after virus inoculation.

(5) *RR–3420.*—This was obtained from Fuga bull 3420, which was vaccinated with 10 cc of glycerine-formolized rinderpest vaccine September 27, 1934; inoculated with 1 cc of fresh virulent blood October 10; developed a severe rinderpest reaction (high thermal reaction for 5 days plus diarrhœa for 2 days); and finally was bled for serum November 5, 26 days after virus inoculation.

HYPERIMMUNE SERA

(1) *HI–3541 (from a marked reactor with a lapsed titer).*—This was obtained from Fuga bull 3541, which was simultaneously injected with 12 cc of antirinderpest immune serum and 2 cc of fresh virulent blood February 20, 1935; developed a high thermal reaction for 6 days; was injected intramuscularly with 1,500 cc (7 cc per kilo body weight) of fresh virulent blood June 3 (103 days after the preliminary virus inoculation) and a similar amount June 13 (fig. 7); and finally was bled for hyperimmune serum June 24, 11 days after the last massive virus injection.

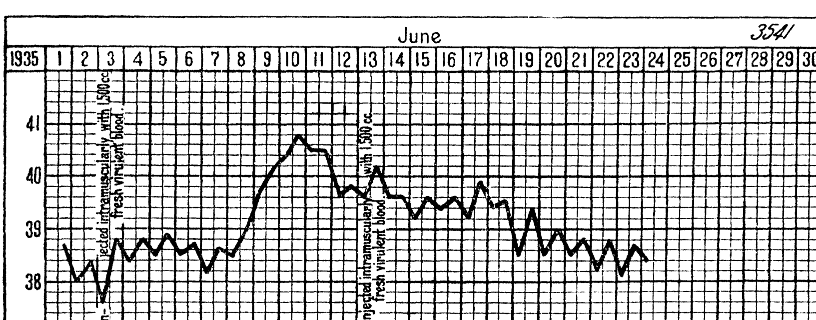

FIG. 7. Temperature chart of hyperimmune serum producer 3541 (formerly producer of marked reactor serum, TR–3541).

(2) *HI–3585 (from a mild reactor)*.—This was obtained from Fuga bull 3585 (producer of mild reactor serum, TR–3585), which was injected intramuscularly with 3,000 cc (17 cc per kilo body weight) of fresh virulent blood December 29, 1934 (24 days after the preliminary virus inoculation), and a similar amount January 9 (fig. 8); and finally was bled for hyperimmune serum January 24, 14 days after the last massive virus injection.

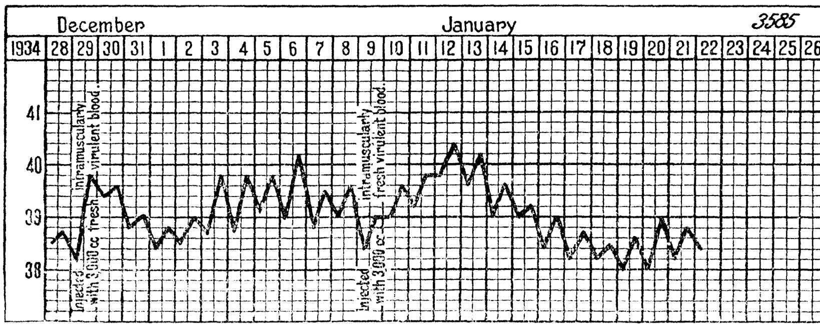

FIG. 8. Temperature chart of hyperimmune serum producer 3585 (formerly producer of mild reactor serum, TR–3585).

(3) *HI–3403 (from a marked reactor)*.—This was obtained from Fuga bull 3403 (producer of marked reactor serum, TR–3403), which was injected intramuscularly with 4,000 cc (19 cc per kilo body weight) of virulent blood November 7, 1934 (28 days after the preliminary virus inoculation), and a similar amount November 14 (fig. 9); and finally was bled for hyperimmune serum December 10, 26 days after the last massive virus injection.

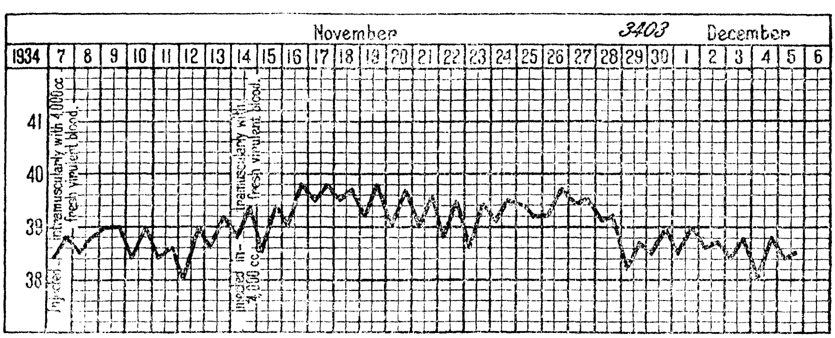

FIG. 9. Temperature chart of hyperimmune serum producer 3403 (formerly producer of marked reactor serum, TH–3403).

(4) *HI–3566 (from a marked reactor)*.—This was obtained from Fuga bull 3566 (producer of marked reactor serum, TR–3566), which was injected intramuscularly with 1,500 cc (7 cc per kilo body weight) of fresh virulent blood June 3, 1935 (27 days after the preliminary virus inoculation), and a similar amount June 13 (fig. 10); and finally was bled for hyperimmune serum June 24, 11 days after the last massive virus injection.

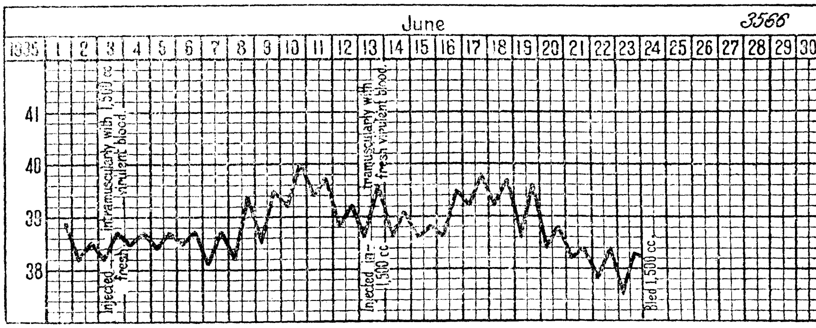

FIG. 10. Temperature chart of hyperimmune serum producer 3566 (formerly producer of marked reactor, TR-3566).

PREPARATION OF THE SERUM

Blood drawn from each serum producer was collected in 2-liter sterile Pyrex bleeding tubes which contained 10 cc of 95 per cent ethyl alcohol. It was then allowed to stand at room temperature for 24 hours, after which the serum was poured into appropriate containers and subsequently stored at 0° to 3° C. until used.

METHOD OF TESTING THE SERUM

Native cattle 2 to 4 years old and weighing from 175 to 286 kilos were used; and these animals, coming from Fuga, Romblon, and Zamboanga where rinderpest has not been known to exist for many years, are noted for their high susceptibility to rinderpest. The required dose of serum, which was based on the body weight, and 2 cc of fresh virulent blood were simultaneously inoculated into these animals. (Controls were likewise inoculated with the blood used in each test; all of them developed clinical or severe rinderpest reactions.)

Those animals that failed to show any response to the virus within a period of two weeks were declared to have had no reaction; those which had developed only a temperature response were either considered to have had a low (below 40° C.) or a high (40° C. or over) thermal reaction; those which had exhibited visible clinical symptoms of rinderpest, such as lacrimation, nasal discharges, and mouth ulceration, were said to have had a clinical rinderpest reaction; and those which had developed the above-mentioned clinical symptoms plus diarrhœa, were considered to have had a severe rinderpest reaction. The last two types of reaction were interpreted as negative results, for in both instances inadequacy of protective power was evident.

TESTS AND RESULTS

NONREACTOR IMMUNE SERA

As shown in Table 1, of the two test animals injected with 10 cc per 100 kilos body weight of nonreactor serum, none was adequately protected; but at 40 cc the serum showed a high degree of protective power. And in two other tests (experiments 5 and 6) an equivalent dosage of 100 cc of nonreactor serum was sufficient to prevent any reaction in the test animals.

TABLE 1.—*Tests on nonreactor immune sera and results.*

Experiment No.	Serum No.	Dosage per 100 kilos.	Actual dose.	Bull No.	Results after virus inoculation.
		cc.	*cc.*		
1	NR-3409	40	103	3523	High thermal reaction for 1 day.
2	NR-3409	10	22	3551	Clinical rinderpest reaction.
3	NR-3510	40	94	3503	High thermal reaction for 5 days.
4	NR-3510	10	21	3567	Severe rinderpest reaction.
5	NR-3680	100	200	3682	No reaction.
6	NR-3684	100	180	3689	Do.

REACTOR IMMUNE SERA

The results shown in Table 2 indicate that mild reactor sera, when given at 10 cc per 100 kilos body weight, were able to protect 1 of 5 test animals; while the marked reactor sera were able to protect in 6 of 7 tests. Likewise, at the equivalent dosage of 40 cc, the former protected 1 of 3 test animals. It would thus appear that the minimum protective dose of the mild reactor serum lies above 40 cc and that of the marked reactor serum is at 10 cc per 100 kilos body weight.

In actual practice, however, the use of such minimum dosage is attended with some risk, as very susceptible animals (see experiment 19) may not be adequately protected by it.

HYPERIMMUNE SERA

As seen in Table 3, all of the hyperimmune sera were protective at 10 cc per 100 kilos body weight; but at 5 cc 4 of 8 test animals developed clinical or severe rinderpest reactions. Hence, for practical purposes the amount of 10 cc per 100 kilos body weight may be considered as the minimum protective dose of the hyperimmune sera.

The beneficial effect of hyperimmunization on marked reactor sera, TR–3403 and TR–3566, was thus practically nil. However, in the case of the marked reactor serum, TR–3541, the

titer of which was allowed to lapse, and of the mild reactor serum, TR–3585, the increase in titer is clearly apparent.

TABLE 2.—*Tests on reactor immune sera and results.*

Experiment No.	Serum No.	Dosage per 100 kilos.	Actual dose.	Bull No.	Results after virus inoculation.
		cc.	*cc.*		
7	TR-3585	40	120	3561	Clinical rinderpest reaction.
8	TR-3585	10	19	3698	High thermal reaction for 3 days.
9	TR-3585	10	22	3675	Severe rinderpest reaction.
10	TR-3662	40	70	3671	High thermal reaction for 2 days.
11	TR-3662	10	20	3658	Severe rinderpest reaction.
12	TR-3662	10	28	3683	Do.
13	TR-3259	40	70	3586	Do.
14	TR-3259	10	27	3559	Do.
15	TR-3566	10	19	3662	High thermal reaction for 5 days.
16	TR-3566	5	10	3693	High thermal reaction for 3 days.
17	TR-3566	5	10	3699	Do.
18	TR-3623	10	29	3706	High thermal reaction for 5 days.
19	TR-3623	10	19	3663	Severe rinderpest reaction.
20	TR-3660	10	18	3668	High thermal reaction for 5 days.
21	TR-3660	10	21	3653	High thermal reaction for 3 days.
22	TR-3403	40	93	3526	No reaction.
23	TR-3403	20	43	3524	High thermal reaction for 1 day.
24	TR-3403	20	36	3563	High thermal reaction for 4 days.
25	TR-3403	10	19	3571	High thermal reaction for 5 days.
26	RR-3420	40	70	3585	Low thermal reaction for 3 days.
27	RR-3420	10	20	3556	Low thermal reaction for 4 days.

TABLE 3.—*Tests on hyperimmune sera and results.*

Experiment No.	Serum No.	Dosage per 100 kilos.	Actual dose.	Bull No.	Results after virus inoculation.
		cc.	*cc.*		
28	[a] HI-3541	10	19	3615	High thermal reaction for 5 days.
29	HI-3541	5	10	3647	Do.
30	HI-3541	5	13	3692	High thermal reaction for 6 days.
31	HI-3585	10	21	3572	Do.
32	HI-3585	5	10	3565	Clinical rinderpest reaction.
33	HI-3585	5	10	3549	Severe rinderpest reaction.
34	HI-3403	10	27	3456	No reaction.
35	HI-3403	10	21	3564	Low thermal reaction for 7 days.
36	HI-3403	5	12	3541	Clinical rinderpest reaction.
37	HI-3403	5	9	3574	Severe rinderpest reaction.
38	HI-3566	5	11	3707	High thermal reaction for 4 days.
39	HI-3566	5	12	3702	High thermal reaction for 5 days.

[a] This serum prior to hyperimmunization failed to protect bull 3639 at 40 cc and bull 3615 at 10 cc per 100 kilos body weight.

COMMENT

The data presented herein are far from being conclusive in some respects, but the indications are clear. So, if we regard

the few discrepant results as being largely due to marked differences in the susceptibility of the test animals used, the data will serve as a basis for a rational interpretation of some of the existing controversial opinions on the subject.

In the present study the tests were performed on individual samples of immune and hyperimmune sera. Besides, the thermal response was adopted as the guide in determining the severity of the original reaction of the serum producers. Consequently it was possible to correlate with certainty such reaction to the titer or protective value of the serum produced, which otherwise would not be possible to do if "pooled samples" were used.

The use of "pooled samples," as heretofore practiced by many investigators, should thus be looked upon as one of the most fruitful sources of the so-called "surprising experimental results." In the first place the average titer of a pooled sample is difficult to foretell. It may be high or low depending on the predominance of sera of correspondingly high or low titer. Thus, if the reactor sera listed in Table 2 were pooled their average titer might be equal to that of the nonreactor serum, as claimed by Ruediger (1910) and Hall (1933), or it might be slightly higher (Ward and Wood, 1912). Similar contrasting results might likewise be obtainable from a pooled sample of the hyperimmune sera shown in Table 3. Furthermore, the correlation of the average titer to the original reaction of the serum producers is obviously difficult or confusing. This is especially true when so many variable factors, such as temperature and visible clinical symptoms (catarrh, stomatitis, and diarrhœa) are considered in the interpretation of such reaction.

Another source of confusion is in the use of excessive amounts of serum. As seen in Table 1, a dose of 100 cc of nonreactor serum per 100 kilos body weight prevented the development of any reaction. Such result cannot certainly be improved by any reactor or hyperimmune serum. Hence, it would appear that the determination of the minimal protective dose of any antirinderpest serum should precede the assessment of its relative efficacy; otherwise the latter loses its significance and value.

So, Stewart (1935), after having observed that field sera manufactured by the process of selecting serum makers on the basis of visible or severe reactions were of varying potency, decided to adopt the thermal response alone as the basis of selection. He used only serum from bovines that had a rise

in temperature of 2° F. above normal for at least two days. As a result he reduced the losses from 6 per cent (when visible clinical symptoms were considered in the selection) to only 1.97 per cent, among 13,530 and 10,047 animals, respectively.

Stewart has thus indicated that the thermal reaction of the serum producer has a direct influence on the titer of its serum. This is corroborated by the results displayed in Table 2, although they also show that a satisfactory reaction in one place may not be the same for another. Under Philippine conditions a thermal reaction of 40° C. or over for at least four days seems to be most suitable for the production of the highest titer in the reactor sera.

That a marked thermal reaction is accompanied by the production of an immune serum of highest titer is thus demonstrated. But as to whether a "maximum titer" is attained after such preliminary reaction to the virus inoculation is still a controversial point. Edwards (1925) claims that such titer is reached, no matter whether the reaction is "blocked-out," "nearly blocked-out," or "mild, but decided;" but Rabagliati (1928) and Bennett (1934) demonstrated that the titer of a pooled reactor serum is invariably increased after hyperimmunization. The data presented in Table 3, however, do not seem to give unequivocal support to either of the above observations. On the other hand the results show that hyperimmunization caused only a noticeable increase in the titer of a marked reactor serum (TR–3541) whose titer was allowed to lapse, and of a mild serum (TR–3585), but such effect was practically nil on marked reactor sera, TR–3403 and TR–3566. The results obviously tend to prove that a maximum titer has already been attained prior to hyperimmunization in the last two marked reactor sera, which was not the case in the first two sera (see text fig. 11).

The following observations, therefore, may be derived from Table 3: (*a*) Hyperimmunization, like any other biological procedure, has its limitations, which should not be ignored in order that its usefulness may not be unduly exaggerated; (*b*) the use of 7 cc of virulent blood per kilo body weight was followed by the production of a relatively higher titer (see HI–3541 and HI–3566) than the use of an equivalent dose of 17 to 19 cc (see HI–3585 and HI–3403); this apparently means that the optimum (?) amount of virus was already present in the smaller dosage and that any excess had no beneficial effect, and if it had

any at all, it was harmful; (*c*) there seems to be a direct relationship between the thermal reaction noted in the temperature charts of hyperimmune serum producers HI–3541 and HI–3585 (figs. 7 and 8), and antibody production; that such behavior was not merely accidental is indicated by the absence of similar reactions in the temperature charts of hyperimmune serum pro-

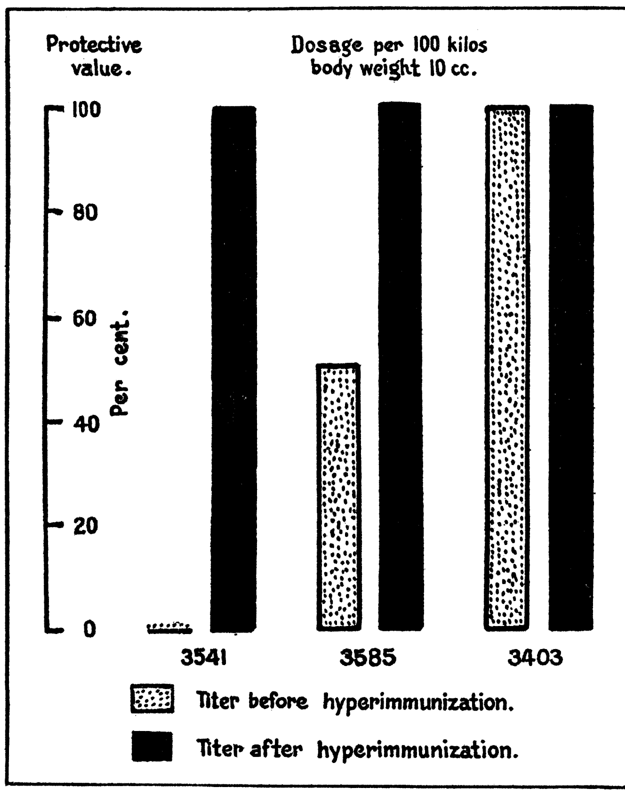

FIG. 11. Showing the effect of hyperimmunization on the titer of antirinderpest reactor immune sera (see Tables 2 and 3).

ducers HI–3403 and HI–3566 (figs. 9 and 10). Observations *b* and *c*, however, require further experimental inquiry before definite conclusions can be drawn concerning them.

SUMMARY

Experimental evidence has been obtained to show that antirinderpest nonreactor immune sera are definitely protective to Philippine cattle, if used in adequate amounts.

Mild reactor sera, or those derived from cattle which had developed a thermal reaction of 40° C. or lower for three days or less, when given in the dosage of 10 cc per 100 kilos body weight protected only one of five test animals; but marked reactor sera, or those derived from cattle which had developed a thermal reaction of 40° C. or higher for four days or more, when given in the same dosage protected six of seven animals.

Evidence has been obtained to show that the titer of a reactor serum varies in direct proportion to the degree and duration of the thermal reaction of the serum producer.

Hyperimmunization was observed to cause an appreciable increase in the titer of a marked reactor serum whose titer was allowed to lapse or of a mild reactor serum; but such effect was not apparent in marked reactor sera of undiminished titer.

Hyperimmune sera used in the dosage of 10 cc per 100 kilos body weight protected all of the four test animals, but in the equivalent dose of 5 cc they failed to protect in four of eight tests.

II. SERUM OF VACCINATED ANIMALS AND THE EFFECT OF VIRUS ON ITS POTENCY

Kakizaki (1925) and Daubney (1928) demonstrated by ordinary simultaneous inoculation tests in susceptible animals that sera of vaccinated animals possess some protective value against rinderpest virus. These results were, however, obtained from apparently infective vaccines. Whether similar results can be obtained from the use of a completely inactivated rinderpest vaccine may thus be determined by the following experiments. Likewise, the effect of virus inoculation into animals vaccinated with such vaccine may be studied.

EXPERIMENTAL DATA

VACCINE SERA

Experiment 1.—Vaccine serum 2260 was obtained from bull 2260, which was vaccinated with 5 cc of chloroform-treated rinderpest vaccine, S–144, March 8, 1933, and bled for serum March 17, 9 days after vaccination. (Control Dalupiri carabao 90, which was vaccinated with 10 cc of S–144 and injected with 2 cc of fresh virulent blood 2 weeks later, developed no reaction to the virus.)

Bull 2726 was injected simultaneously with 300 cc of vaccine serum 2260 (160 cc per 100 kilos body weight) and 2 cc of fresh virulent blood. This animal developed a severe rinderpest reaction and was finally killed for vaccine.

Experiment 2.—Vaccine serum 2232 was obtained from bull 2232, which was vaccinated with 20 cc of S–144 March 1, 1933, and bled for serum March 10, 9 days after vaccination.

Bull 2722 was injected simultaneously with 300 cc of the above serum (160 cc per 100 kilos body weight) and 2 cc of fresh virulent blood. This animal developed a severe rinderpest reaction and was finally killed for vaccine.

Experiment 3.—Vaccine serum 45 was obtained from Dalupiri carabao 45, which was vaccinated with 200 cc of chloroform-treated vaccine, S–166, October 18, 1933, and bled for serum October 28, 10 days after vaccination. (Control Dalupiri carabao 1284, which was likewise vaccinated with 10 cc of S–166 and inoculated with 2 cc of fresh virulent blood 2 weeks later, developed a temperature reaction but recovered.)

Bull 2813 was injected simultaneously with 1,500 cc of vaccine serum 45 (670 cc per 100 kilos body weight) and 2 cc of fresh virulent blood. This animal developed a severe rinderpest reaction and was finally killed for vaccine.

Experiment 4.—Vaccine serum 70 was obtained from Dalupiri carabao 70, which was vaccinated with 200 cc of chloroform-treated vaccine S–169 November 29, 1933, and bled for vaccine serum December 9, 10 days after vaccination. (Control Dalupiri carabao 66, which was likewise vaccinated with 10 cc of S–169 and inoculated with 2 cc of fresh virulent blood 2 weeks later, developed a temperature reaction but recovered.)

Bull 2914 was injected simultaneously with 2,000 cc of vaccine serum 70 (760 cc per 100 kilos body weight) and 2 cc of fresh virulent blood. This animal developed a severe rinderpest reaction and was finally killed for vaccine.

VACCINE SERA (PLUS VIRUS)

Experiment 5.—Vaccine serum 3409 (plus virus) was obtained from bull 3409, which was vaccinated with 10 cc of glycerine-formolized rinderpest vaccine September 24, 1934; inoculated with 1 cc of fresh virulent blood October 10; developed no reaction to the virus; and finally was bled for serum November 5, 26 days after virus inoculation.

Bull 3523 was injected simultaneously with 103 cc of the above serum (40 cc per 100 kilos body weight) and 1 cc of fresh virulent blood 3495. This animal developed only a high thermal reaction for 2 days. (Control bull 3459, which was inoculated with 1 cc of virulent blood 3495, developed a severe rinderpest reaction, and finally was killed for vaccine.)

Experiment 6.—Vaccine serum 3510 (plus virus) was obtained from bull 3510, which was vaccinated with 0.5 g of dried rinderpest vaccine October 24, 1934; inoculated with 1 cc of fresh virulent blood November 7; developed no reaction to the virus; and finally was bled for serum November 29, 22 days after virus inoculation.

Bull 3503 was injected simultaneously with 94 cc of the above serum (40 cc per 100 kilos body weight) and 2 cc of fresh virulent blood 3514. This animal developed a high thermal reaction for 6 days and recovered. (Control bull 3586, which was inoculated with 2 cc of virulent blood 3514, developed a severe rinderpest reaction and finally was killed for vaccine.)

TABLE 4.—*Summary of experiments.*

Experiment No.	Material used. Vaccine serum No.	Amount.	Bull No.	Results after virus inoculation.
		cc.		
1	2260	300	2726	Severe rinderpest reaction.
2	2232	300	2722	Do.
3	45	1,500	2813	Do.
4	70	2,000	2914	Do.
5	3409 (plus virus)	103	3523	High thermal reaction for 2 days.
6	3510 (plus virus)	94	3503	High thermal reaction for 6 days.

COMMENT

The results of experiments 1 to 4 show that completely inactivated but potent rinderpest tissue vaccines were unable to produce sera of demonstrable protective value against rinderpest virus. It is thus evident that the type or degree (?) of immunity developed by such vaccines is quite different from that engendered by an infective one, or another that may contain living virus in subinfective doses. The presence of unmodified active rinderpest virus in the tissue vaccine, therefore, may be looked upon as superfluous and a source of danger for the infection that it may produce in some vaccinated animals; for without such active virus the vaccine still retains its full immunizing property.

On the other hand, the results of experiments 5 and 6 demonstrate that the inoculation of living rinderpest virus into vaccinated animals, even if "no reaction" resulted from such inoculation, was invariably followed by the production of an "immune serum" of definite immunizing property. Similar results were observed in other experiments not included herein. Likewise the results obtained by Kakizaki (1925) and Daubney (1928) on vaccine sera apparently fall in the same category.

Thus, the moot question of whether the rinderpest tissue vaccine owes its immunizing property to a dead or to a subinfective dose of living virus has been partially answered by the preceding experiments. Certainly its inability to produce an "immune serum" makes it evident that such vaccine does not contain an unmodified living rinderpest virus.

SUMMARY

Experimental evidence has been obtained to show that a completely inactivated rinderpest tissue vaccine was unable to pro-

duce a serum of demonstrable protective value. However, the inoculation of living rinderpest virus into vaccinated animals, even if "no reaction" resulted from such inoculation, was invariably followed by the production of an "immune serum" of definite immunizing property.

III. THE SPLEEN AND LYMPH GLANDS OF RINDERPEST-RECOVERED ANIMALS FOR IMMUNIZATION

The efficacy of vaccines prepared from the spleen and lymph glands of rinderpest-infected animals (killed at the height of the disease) by proper inactivation of the virus with chemicals or by desiccation has been demonstrated by many investigators (Kakizaki et al., 1928; Kelser et al., 1928; Jacotot, 1932; Robles and Generoso, 1933; and others). Yet, whether such vaccines owe their immunizing value to the inactivated or dead rinderpest virus or to other substances contained in the organs used is still a matter of conjecture.

Jacotot (1932) demonstrated that avirulent blood, peritoneal fluid, and abomasal mucosa obtained from rinderpest-infected animals do not possess any immunizing value. Hence, he believes that the vaccinating property of certain organs is not due to the virus but to a "fragile substance," which can be stabilized by dehydration or treatment with chemicals. When this substance is inoculated it fixes itself to the cellular elements sensitive to the rinderpest virus; its rôle is thus purely passive. Saceghem (1933) calls this substance a "toxin," which he believes to be transformed into an anatoxin (toxoid) by the addition of formalin. Kelser et al. (1928), being unable to obtain any immunizing value from blood rich in rinderpest virus, likewise suggest that the immunizing principle contained in certain organs is "either some biproduct of the reaction between tissue and virus or rinderpest virus that has been changed in some particular way by the activity of the solid tissues." Boynton (1935), on the other hand, believes that a tissue vaccine, like the rinderpest vaccine, apparently owes its immunizing property not to the killed virus, but to a "modified living virus" (modified by chemicals) that has lost its disease-producing power but still retains its ability to stimulate antibody formation in the animal body.

All of the above presumptions are apparently based upon mere inferences from negative experimental results. The reason is

obvious; and as long as we keep on using composite tissue vaccines and are unable to cultivate in pure culture the virus of rinderpest, the true nature of the immunizing substance in the vaccine will remain indeterminate.

Nevertheless, an attempt will be made in the following experiments to demonstrate whether or not the spleen and lymph glands of rinderpest-recovered cattle possess any immunizing value (active or passive).

MATERIALS AND METHODS

EXTRACTS OF SPLEEN AND LYMPH GLANDS FROM RINDERPEST-RECOVERED ANIMALS

No. 3259.—Fuga bull 3259 was vaccinated with 0.5 g of dried rinderpest vaccine September 19, 1934; inoculated with 1 cc of virulent blood October 3; and finally developed a high thermal reaction for 3 days (October 7 to 9). The spleen and lymph glands were removed November 11, 33 days after virus inoculation.

No. 3403 (hyperimmunized).—Fuga bull 3403 was vaccinated with 10 cc of glycerine-formolized rinderpest vaccine September 27, 1934; inoculated with 1 cc of fresh virulent blood October 10; developed a high thermal reaction for 6 days; and was hyperimmunized with 4,000 cc of fresh virulent blood November 7 and a similar amount November 14. The spleen and lymph glands were removed December 10, 26 days after the last massive virus injection.

No. 3623.—Fuga bull 3623 (fig. 12) was inoculated with 10 cc of virulent blood August 7, 1935, and subsequently developed a high thermal reaction for 6 days (August 10 to 15). The spleen and lymph glands were removed August 22, 15 days after virus inoculation (6 days after the temperature had dropped below 40° C.).

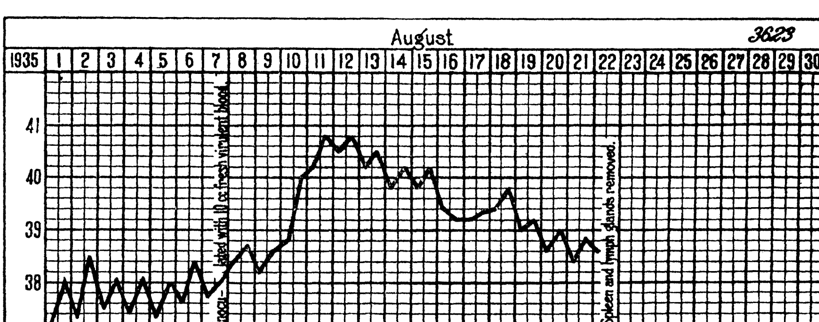

FIG. 12. Temperature chart of rinderpest-recovered bull whose spleen and lymph glands were used in the preparation of organ extract 3623.

No. 3647.—Fuga bull 3647 (fig. 13) was injected simultaneously with 10 cc of hyperimmune serum and 2 cc of virulent blood August 14, 1935, and subsequently developed a high thermal reaction for 5 days (August 18 to 22). The spleen and lymph glands were removed August 28, 14 days after virus inoculation (5 days after the temperature had dropped below 40° C.).

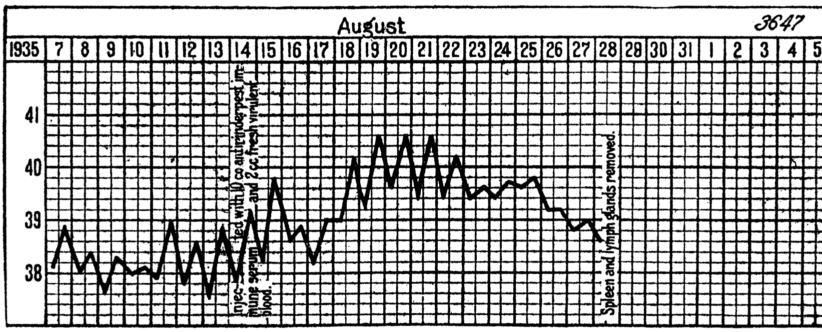

FIG. 13. Temperature chart of rinderpest-recovered bull whose spleen and lymph glands were used in the preparation of organ extract 3647.

No. 3675.—Romblon bull 3675 (fig. 14) was injected simultaneously with 70 cc of immune serum and 2 cc of virulent blood September 25, 1935, and subsequently developed a high thermal reaction for 4 days (September 29 to October 2). The spleen and lymph glands were removed October 10, 15 days after virus inoculation (7 days after the temperature had dropped to 40° C.).

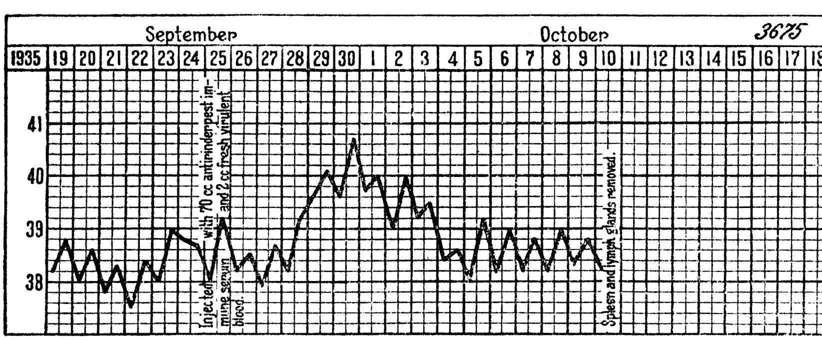

FIG. 14. Temperature chart of rinderpest-recovered bull whose spleen and lymph glands were used in the preparation of organ extract 3663–3675.

No. 3663.—Romblon bull 3663 (fig. 15) was injected simultaneously with 19 cc of immune serum and 2 cc of virulent blood September 25, 1935, and subsequently developed a high thermal reaction for 4 days (September 30 to October 3) and diarrhœa for 3 days. The spleen and lymph glands were removed October 10, 15 days after virus inoculation (7 days after the temperature had dropped to 40° C.).

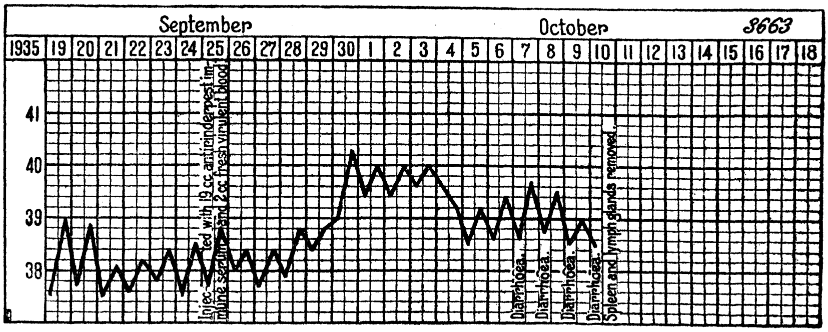

FIG. 15. Temperature chart of rinderpest-recovered bull whose spleen and lymph glands were used in the preparation of organ extract 3663–3675.

PREPARATION OF ORGAN EXTRACTS

The spleen and lymph glands that were removed from each animal were trimmed of their fat and fascia, disinfected with 5 per cent phenol for 10 minutes, rinsed with water, and cut into thin slices. These were steeped overnight in sterile physiological saline, which was subsequently discarded so as to remove whatever traces of immune serum or fluids were present in the tissues. They were then ground in a meat chopper, triturated in a mortar, and strained through 18-mesh wire gauze. To the strained pulp distilled water was added so as to make a 20 per cent suspension. The mixture was then shaken thoroughly with glass beads and stored at 0° to 3° C. for 24 hours, after which it was filtered by trituration through 50-mesh wire gauze. The filtrate obtained was a thick reddish brown liquid, and the residue that was discarded consisted largely of connective-tissue capsules and trabeculæ.

METHOD OF TESTING THE ORGAN EXTRACTS

Susceptible cattle were subcutaneously injected with 500 cc of the freshly prepared organ extracts (containing approximately 80 grams of tissue pulp) and then inoculated with 2 cc of fresh virulent blood, either simultaneously or 7 to 54 days later. Animals that developed a clinical rinderpest reaction accompanied by diarrhœa were declared to have had a severe rinderpest reaction, and those that had only a thermal reaction or no reaction were recorded.

EXPERIMENTS AND RESULTS

Experiment 1.—Organ extract 3259 was injected in 500-cc amounts into Mindoro bulls 3522 and 3515. The former was inoculated simultaneously with 2 cc of virulent blood and the latter 7 days later.

Both of the above animals developed severe rinderpest reactions.

Experiment 2.—Organ extract 3403 was injected in 500-cc amounts into Fuga bulls 3579, 3576, and 3577. These animals were inoculated with 2 cc of virulent blood, simultaneously, 10 days later, and 21 days later, respectively.

The first two animals developed severe rinderpest reactions, while the last (inoculated with virus 21 days later) developed only a high thermal reaction for 2 days.

Experiment 3.—Organ extract 3623 was injected in 500-cc amounts into Romblon bulls 3657 and 3654. The former was inoculated simultaneously with 2 cc of virulent blood and the latter 14 days later.

Bull 3657 developed a severe rinderpest reaction, while No. 3654 developed only a low thermal reaction for 5 days.

Experiment 4.—Organ extract 3647 was injected in a 500-cc amount into Romblon bull 3648, simultaneously with 2 cc of virulent blood.

The above animal developed a severe rinderpest reaction.

Experiment 5.—Organ extracts 3663 and 3675 were pooled and inoculated in 500-cc amounts into Fuga bulls 3550, 3560, 3557, and 3687. The first two were inoculated with virus 14 days later and the last two 54 days later.

Bulls 3550, 3560, and 3557 developed a high thermal reaction for 5, 4, and 3 days, respectively. Bull 3687 developed a severe rinderpest reaction.

TABLE 5.—*Summary of experiments and results.*

Experiment No.	Organ-extract No.	Manner of testing with virus.	Bull No.	Results after virus inoculation.
1	3259	Simultaneously	3522	Severe rinderpest reaction.
1	3259	Seven days later	3515	Do.
2	3403	Simultaneously	3579	Do.
2	3403	Ten days later	3576	Do.
2	3403	Twenty-one days later	3577	High thermal reaction for 2 days.
3	3623	Simultaneously	3657	Severe rinderpest reaction.
3	3623	Fourteen days later	3654	Low thermal reaction for 5 days.
4	3647	Simultaneously	3648	Severe rinderpest reaction.
5	3663-3675	Fourteen days later	3550	High thermal reaction for 5 days.
5	3663-3675	do	3560	High thermal reaction for 4 days.
5	3663-3675	Fifty-four days later	3557	High thermal reaction for 3 days.
5	3663-3675	do	3687	Severe rinderpest reaction.

COMMENT

The results of experiments 3 to 5 show that the spleen and the lymph glands of rinderpest-infected animals were no longer virulent on the fifth or seventh day after the temperature had dropped below 40° C., 14 to 15 days after virus inoculation (text figs. 12 to 15). This behavior is quite similar to that of the blood,

for Ward et al. (1914) record a rinderpest case whose blood proved noninfective on the thirteenth, fifteenth, seventeenth, nineteenth, and twenty-first days after virus inoculation. Todd (1930) likewise states that the appearance of rinderpest virus in the blood seems to coincide with the period of fever and disappears normally with the subsidence of temperature. However, in spite of their noninfectivity, the same spleen and lymph glands demonstrated some immunizing power, provided that an interval of at least 7 days was allowed to elapse before a test dose of virus was given; but not when the virus was inoculated simultaneously.

The behavior of the immunizing substance contained in those organs is thus similar to that of an antigen but unlike that of antibodies; and it seems to diminish quite rapidly after an acute rinderpest infection, as organs obtained 14 to 15 days after virus inoculation (experiments 3 to 5) indicated a higher protective power than those obtained 26 to 33 days later (experiments 1 and 2). It may be presumed, therefore, that the antigen concentration in the spleen and lymph glands of rinderpest-infected animals is at its highest 6 to 7 days after virus inoculation, as tissue extracts prepared at this period have been commonly observed to give the best results. Besides, such antigen seems to be either a residual "changed virus" or a "reaction product" (a toxin as suggested by Saceghem) between virus and tissues, but obviously not an "unmodified living virus," otherwise the inoculated animals would not have been susceptible to the test dose of virulent blood (experiments 1 to 5).

SUMMARY

The spleen and lymph glands of rinderpest-infected animals, 5 to 7 days after the subsidence of temperature below 40° C. or 14 to 15 days after virus inoculation, were no longer virulent. However, extracts prepared from them and injected in 500-cc (20 per cent emulsion) amounts were able to protect four of five test animals, when followed by virus inoculation 14 to 54 days later; but when simultaneously injected with virulent blood, they failed to show any protective value.

The immunizing substance contained in the spleen and lymph glands of rinderpest-infected animals seems to be some form of antigen, which disappears quite rapidly after an acute rinderpest reaction, as organ extracts obtained 26 to 33 days after virus inoculation protected only one of three test animals, when followed by virus 7 to 21 days later.

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ILLUSTRATIONS

TEXT FIGURES

IMMUNITY IN RINDERPEST-VACCINATED ANIMALS

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Rinderpest immunity after vaccination appears to have been first studied by Kakizaki (1925), who demonstrated that the serum of vaccinated animals apparently possesses some protective value when inoculated into susceptible animals. This was confirmed by Daubney (1928). On the other hand, Robles (in this issue) failed to verify such finding when he used a completely inactivated dried-tissue vaccine, but he indicated that the serum of vaccinated animals acquires a definite immunizing property when vaccination is followed by virus.

However, no reference is available to show that cellular immunity after inoculation of rinderpest-tissue vaccine has ever been investigated. Thus, it is the object of the present study to determine whether or not the cells of the lymph glands of rinderpest-vaccinated animals possess any power of destroying or neutralizing the virus of rinderpest.

The possibility of such behavior has been suggested by the work of Levaditi (cited by D'Herelle, 1924), who after passing vaccinia virus many times through the brains of rabbits obtained a true "fixed" vaccinia virus, which causes a fatal meningitis; however, if such a virus is introduced into the brain of a previously vaccinated rabbit, it is quickly destroyed, so that after some hours it can no longer be demonstrated. Levaditi has thus shown that "it is the susceptible cells which acquire the immunity and that this immunity is due to the fact that these cells are able to destroy the virus."

Since the announcement by Besredka (1927) a decade ago that immunity may be established without the obligatory participation of antibodies, a field was opened which culminated in the investigation of various mechanisms in the immunity involved in various infectious diseases. In the light of this new concept some of the most important recent advances in vaccine therapy have tended to converge into Besredka's theory of local immunization. Vaccination against vaccinia, smallpox, fowl pox, foot-and-mouth disease, and anthrax may be cited.

The results of his classical experiments on anthrax cuti-immunization, the oral vaccination against dysentery and typhoid, and the application of antivirus dressings on the skin against the staphylococcus and streptococcus infections were far-reaching and deserve further confirmation or repudiation before we pass upon them lightly. Intradermal immunization against anthrax with the spore vaccine is now an accepted fact, and hundreds upon thousands of animals in Europe and America have already been vaccinated by this method with good results.

More recently Gochenour et al. (1935) reported that in the testing of the various types of anthrax vaccine produced in the United States by commercial houses the intradermal spore vaccine administered in 0.5 cc doses has given the most enduring immunity. Likewise, it is widely known that immunity in rabies vaccination, whether with virulent or killed fixed virus, is generally followed by the ability of the vaccinated animals to resist subdural injection of virulent fixed brain virus, showing again the specific immunity conferred on the nerve cells. Such cellular immunity has been observed in other infections, but the above list suffices to demonstrate the existence of this immunity mechanism.

MATERIALS AND PROCEDURE

Vaccinated animals.—Cattle and carabaos were vaccinated intramuscularly on the left side of the back just behind the shoulder blade with varying amounts of dried rinderpest vaccine as follows:

	g.
Fuga bull 3553	0.5
Fuga bull 3556	1.0
Fuga bull 3558	1.0
Fuga bull 3680	5.0
Fuga bull 3684	5.0
Dalupiri carabao 1409	2.5
Dalupiri carabao 1412	10.0
Dalupiri carabao 1402	10.0

Two weeks after vaccination, when immunity was already established, the animals were subjected to intraglandular inoculation of virulent blood.

Technic of intraglandular virus inoculation.—The vaccinated animal was properly restrained on an operating table. The right precrural lymph gland was exposed by a cutaneous incision and careful dissection. One-half cubic centimeter of fresh citrated virulent blood was then introduced into the gland substance by means of a 23-gauge hypodermic needle. The point

of inoculation was immediately cauterized with a hot spatula so as to avoid the escape of blood outside the gland. The skin wound was finally sutured and the wound dressed with sterile vaseline or ether-collodion. All animals that received the intraglandular virus inoculation were isolated and observed for two weeks.

Testing the virus-infected gland.—Twenty-four hours after virus inoculation the lymph gland was dissected out, trimmed of its connective-tissue capsule, ground finely in a meat grinder, triturated in a mortar with 100 cc of sterile distilled water, and filtered through a double thickness of gauze. The filtrate was then injected subcutaneously into susceptible animals. These were also observed for two weeks, and if not infected were released for the final susceptibility tests.

Testing the serum obtained after intraglandular virus inoculation.—Sera from four vaccinated animals were obtained fourteen days after the intraglandular virus inoculation and tested for their protective value against rinderpest virus in highly susceptible cattle.

EXPERIMENTS AND RESULTS

EXPERIMENTS ON THE VIRUS-INFECTED GLANDS

Experiment 1.—Bull 3553 was vaccinated February 26, 1935, and received 0.5 cc of fresh virulent blood intraglandularly two weeks later. There was no reaction to the virus. Its gland extract was injected into Fuga bull 3548, but no evidence of infection appeared.

Control.—Bull 3568 (unvaccinated) was inoculated in the same manner with 0.5 cc of the blood used above. Its gland extract proved infective to Fuga bull 3545.

Experiment 2.—Bulls 3555 and 3558 were vaccinated March 27, 1935, and both were inoculated intraglandularly with 0.5 cc of virulent blood two weeks later. As a result the former developed no reaction and the latter showed a marked thermal reaction for five days followed by recovery. The gland extract obtained from bull 3555 was injected into Romblon bull 3631 (2a) but proved avirulent, while the gland extract obtained from bull 3558 proved infective to Romblon bull 3633 (2b).

Experiment 3.—Fuga bulls 3680 and 3684 were vaccinated October 23, 1935 and inoculated intraglandularly with 0.5 cc of blood four weeks later (November 26); neither developed a reaction to the virus. Their gland extracts when injected into Fuga bulls 3674 and 3677, respectively, proved avirulent.

Experiment 4.—Dalupiri carabao 1409 was vaccinated September 18, 1935 and inoculated intraglandularly with 0.5 cc of fresh virulent blood two weeks later; it developed a high thermal reaction for five days but recovered. Its gland extract when injected into Fuga bull 3681 proved infective.

Control.—The gland extract from Dalupiri carabao 1407 (unvaccinated), which was treated in the same manner as No. 1409, proved infective to Fuga bull 3679.

Experiment 5.—Dalupiri carabaos 1402 and 1412 were vaccinated October 23, 1935 and inoculated intraglandularly with 0.5 cc virulent blood four weeks later (November 26); developed no reaction to the virus. Their gland extracts when injected into Fuga bulls 3667 and 3665, respectively, proved avirulent.

TABLE 1.—*Summary of experiments 1 to 5.*

Experiment No.	Test animal No.	Gland No.	Type of gland.	Result after gland-extract injection.	Result after injection of 1 cc virulent blood.
1	3548	3553	Vaccinated	Not infected	Typical rinderpest.
	3545	3568	Control	Infected	
2a	3631	3555	Vaccinated	Not infected	Do.
2b	3633	[a] 3558	do	Infected	
3a	3674	3680	do	Not infected	Do.
3b	3677	3684	do	do	Do.
4	3681	[a] 1409	do	Infected	
	3679	1407	Control	do	
5a	3667	1402	Vaccinated	Not infected	Do.
5b	3665	1412	do	do	Do.

[a] Developed five days of thermal reaction after intraglandular virus inoculation.

EXPERIMENTS ON THE SERUM OBTAINED AFTER INTRAGLANDULAR VIRUS INOCULATION

Experiment 6.—Fuga bulls 3680 and 3684 (in experiment 3) were vaccinated October 23, 1935 and inoculated with fresh virulent blood four weeks later (November 26); neither developed a reaction to the virus. December 10 each of these animals was bled for serum, which was separately injected, in 200-cc amounts together with 2 cc of fresh virulent blood, into Fuga bulls 3689 and 3682, respectively. Neither of these animals developed any reaction, showing that the serum was protective.

Experiment 7.—Dalupiri carabaos 1402 and 1412 (in experiment 5) were vaccinated October 23, 1935 and inoculated with fresh virulent blood four weeks later (November 26); neither developed any reaction to the virus. December 10 each of these animals was bled for serum, which was separately injected, in 200-cc amounts together with 2 cc of fresh virulent blood, into Fuga bulls 3691 and 3695, respectively. The former failed to develop a reaction to the virus; while the latter, No. 3695, which was injected with the serum of Dalupiri carabao 1412, developed a severe rinderpest reaction.

Control.—Fuga bull 3690, which was inoculated with 2 cc of fresh virulent blood used in experiments 6 and 7, likewise developed a severe rinderpest reaction.

COMMENT

The virulent blood introduced into the lymph gland in the preceding experiments may be divided into two parts; namely, residual and circulating. The first, as its name would indicate,

remains in the gland substance, while the latter goes into the general circulation.

As shown by the infectivity of lymph glands from unvaccinated animals (controls), there remains a sufficient amount of residual rinderpest virus in the gland after a lapse of twenty-four hours. This is true for both cattle and carabaos. But in the lymph glands of vaccinated animals such residual virus appears to have been completely or partly destroyed. The destruction was complete when the vaccine immunity was of a high order, as in the vaccinated animals that developed no reaction to the intraglandular virus inoculation; or incomplete, when the immunity was of a low order as in the animals that developed a thermal reaction (see experiments 2b and 4). It appears that the degree of cellular and local immunity present in the lymph glands may be taken as a measure of the general immunity established in the animal.

It should be noted that all test animals that were not infected by the lymph-gland extract inoculation later proved to be susceptible to rinderpest. This behavior suggests that all traces of residual virus (sufficient to cause "inapparent infection") have been disposed of and completely destroyed by the glands.

On the other hand it will be noted that the serum of vaccinated animals apparently does not contain antiviral bodies. This is shown in experiments 6 and 7, wherein the inability of the animal to destroy the circulating fraction of the inoculated virus led to the production of an "immune" serum. These results confirm the work of Robles (in this issue) that the sera of vaccinated animals possess no protective value.

In view of the preceding considerations, we are led to believe that the immunity induced by vaccination with completely inactivated rinderpest-tissue vaccines is largely, if not wholly, a local cellular immunity which resides in the lymph glands and perhaps in other lymphoid organs of the body. Since immunity in vaccinated animals is not permanent and the fact that the serum obtained from them does not seem to have any demonstrable protective value, it appears that immunity in these cases may be either a simple fortified passive immunity or a very low degree of active immunity.

SUMMARY

Experimental evidence has been obtained to show that the lymph glands of rinderpest-vaccinated cattle and carabaos possess the ability of neutralizing the rinderpest virus in vivo.

This may be taken as a measure of the degree of general immunity produced in the animal body.

The immunity induced in vaccinated animals appears to be purely local and cellular in character, as shown by the ability of their lymph glands to neutralize the virus completely when it remains in those organs. The lack of protective value of the serum of vaccinated animals sustains the belief that a humoral immunity is not operating. It is very likely a form of fortified passive immunity or a very low degree of active immunity, which resides in the lymph glands and other lymphoid organs of the body.

The serum of vaccinated animals does not contain antiviral bodies. This was indicated by its inability to neutralize the rinderpest virus that gained entrance into the circulation and thereby permitted the production of a protective "immune" serum.

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STUDIES ON THE CERCARICIDAL PROPERTY OF THE SERA OF VERTEBRATE ANIMALS [1]

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One of the most recent contributions to our knowledge of the properties of the normal sera of vertebrate animals is that of Culbertson and Talbot (1935) on the antagonistic action exhibited by some of these fluids against the cercarial stages of trematode parasites. According to these writers, the cercaricidal test would be useful in the determination of the complete cycles of these larval forms if evidence could be obtained to show that a relationship exists between the cercaricidal power of the serum of an animal and the resistance of that animal to infection with a given cercaria. The present studies were undertaken partly for the purpose of extending the observations of Culbertson and Talbot and partly in order to inquire into the probable mechanism of the cercaricidal action.

MATERIAL AND METHODS

Two species of cercariæ were used in the experiments; namely, the cercaria of the blood fluke, *Schistosoma japonicum*, and *Cercaria maitimensis* Tubangui, 1928. Only mature actively swimming larvæ were utilized in the tests. Larval specimens of *C. maitimensis* were obtained by exposing infected snails [*Pila luzonica* (Reeve)] in the sun for a few minutes in order to stimulate the parasites to crawl out into the water. In the case of the cercaria of *Schistosoma japonicum* the snails [*Schistosomophora hydrobiopsis* (Rensch)] were crushed in order to liberate the larvæ.

The serum samples were obtained from the following: Man, monkey, cow, carabao, sheep, goat, cat, rabbit, guinea pig, chicken, frog (*Rana vittigera*), and fish (*Ophiocephalus striatus*). Each serum was used either in the fresh or inactivated state and either pure or dilute. The inactivation was made by heating at 57° C. for 20 to 30 minutes on a water bath. In the prep-

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aration of serum dilutions ordinary artesian-well water was employed instead of physiological salt solution, for it was found that some cercariæ were very susceptible to salt solutions.

In carrying out the tests a volume of water containing the cercariæ was mixed with an equal volume of pure or dilute serum in a deep hollow slide or a small concave dish. The results were read after one hour incubation at 37° C. A serum was considered to possess cercaricidal property if after the period of incubation the cercariæ were found either dead or moribund and much deformed. The result of each test was checked by using a control consisting of a suspension of cercariæ either in water or inactivated serum. In many instances it was possible to foretell that one was dealing with a potent serum by the shedding of the tails of the cercariæ soon after being placed in contact with the serum. In negative tests the larvæ remained actively motile and normal in appearance at the end of the observation period in both the test and the control fluids.

CERCARICIDAL TESTS

The results of the cercaricidal tests are summarized in Table 1, which shows that the various sera, with the exception of those of the cat and the rabbit, possess some destructive effect on the two species of cercariæ used in the experiments. Against *C. maitimensis*, a distomid larva, the various sera were only

TABLE 1.—*Effect of the sera of different kinds of vertebrate animals on the cercaria of Schistosoma japonicum and Cercaria maitimensis.*

Kind of serum.	Species of cercaria.	
	C. schistosoma japonicum.	*C. maitimensis.*
Human	[a] +(1:2)	[a] ±(1:2)
Monkey	+(1:2)	±(1:2)
Cow	+(1:2)	±(1:2)
Carabao	+(1:2)	±(1:2)
Sheep	+(1:2)	±(1:2)
Goat	±(1:2)	±(1:2)
Cat	—	—
Rabbit	—	—
Guinea pig	+(1:4)	±(1:2)
Chicken	+(1:4)	±(1:2)
Fish (*Ophiocephalus striatus*)	+(1:10)	±(1:2)
Frog (*Rana vittigera*)	+(1:88)	±(1:2)

[a] +, All cercariæ killed or rendered moribund and very much deformed; ±, some cercariæ killed or rendered moribund and very much deformed; —, cercariæ alive and normal. Figures in parentheses refer to the maximum titer of a serum against a particular species of cercaria.

partially antagonistic. This finding was probably to be expected, considering that this and related cercariæ do not introduce themselves into the bodies of their vertebrate hosts through the circulatory system. On the other hand, against the cercaria of *Schistosoma japonicum,* which is a blood parasite, the cercaricidal effect was quite marked, although the titers of the different sera varied between appreciably wide limits. The highest-titered sera were found to be those of the fish and the frog, which were potent in dilutions of 1 to 10 and 1 to 88, respectively. The titers of the other sera varied in dilutions between 1 to 2 and 1 to 4. Taking into account these differences and the fact that *Schistosoma japonicum* is not a parasite of cold-blooded vertebrates but of mammals, it appears from the results of the tests that there is an inverse relationship between the cercaricidal titer of the serum of an animal and the susceptibility of that animal to infection with the cercaria. The only exception noted is the low titer of the serum of the chicken, an animal which so far as known is not susceptible to infection with *Schistosoma japonicum.*

MECHANISM OF THE CERCARICIDAL ACTION

Our findings agree with those of Culbertson and Talbot to the effect that the substance in the serum responsible for the cercaricidal action is destroyed by heating and is quickly lost by the serum in storage. The fact that these are also characteristics of that component of the blood known as the complement suggested the probability of the cercaricidal reaction being analogous to the bacteriolytic and other cytolytic phenomena exhibited by normal sera. For this reason another set of experiments was carried out in order to inquire into the probable mechanism of the reaction. The results of the experiments are given in Tables 2, 3, and 4.

The results presented in Table 2 show that a serum like that of the guinea pig, which has lost its cercaricidal activity by heating, may be reactivated by the addition of a small amount of fresh potent serum. It is deduced from these results that the phenomenon involved is a "cercariolytic" reaction due, according to Ehrlich's side-chain theory, to a combination of antigen, amboceptor, and complement. In the experiment cited, the cercaricidal power of the guinea-pig serum was apparently lost due to the destruction of the complement by heating, but was restored when a very small amount of fresh guinea-pig serum was added. Identical results were obtained in parallel tests made

with human serum. Table 2, however, also shows that the reactivation of the heated serum was not accomplished when the fresh serum of either the cat or rabbit was added due to the fact that the sera of these two animals were found deficient in complement. By titrating these sera against an antimonkey hæmolytic system, as developed by Schöbl and Monserrat (1917) in the complement-fixation test for syphilis, it was determined that the titer of their complement was less than one-tenth of that of a normal guinea pig.

TABLE 2.—*Probable mechanism of the cercaricidal action: rôle of complement.*

Kind of serum.	Species of cercaria.	
	C. schistosoma japonicum.	*C. maitimensis.*
Inactivated guinea-pig serum	—	—
Inactivated human serum	—	—
Dilute, fresh guinea-pig serum (1:10)	—	—
Inactivated guinea-pig serum and dilute fresh guinea-pig serum (1:5), equal parts	+	±
Inactivated human serum and dilute fresh guinea-pig serum (1:5), equal parts	+	±
Inactivated guinea-pig serum and fresh rabbit serum, equal parts	—	—
Inactivated guinea-pig serum and fresh cat serum, equal parts	—	—

Table 3 shows that the sera of the cat and the rabbit failed to show any cercaricidal effect even when the amount of complement was increased by the addition of fresh guinea-pig serum. This observation gives the indication that the sera of these two animals are also deficient or are completely lacking in amboceptor.

TABLE 3.—*Probable mechanism of the cercaricidal activity: rôle of amboceptor.*

Kind of serum.	Species of cercaria.	
	C. schistosoma japonicum.	*C. maitimensis.*
Fresh cat serum	—	—
Fresh rabbit serum	—	—
Inactivated cat serum	—	—
Inactivated rabbit serum	—	—
Dilute, fresh guinea-pig serum (1:10)	—	—
Fresh cat serum and dilute fresh guinea-pig serum (1:5), equal parts	—	—
Fresh rabbit serum and dilute fresh guinea-pig serum (1:5), equal parts	—	—
Inactivated cat serum and dilute fresh guinea-pig serum (1:5), equal parts	—	—
Inactivated rabbit serum and dilute fresh guinea-pig serum (1:5), equal parts	—	—

TABLE 4.—*The cercaricidal titer of the serum of a guinea pig infected with Schistosoma japonicum compared with the titer of the serum of a normal guinea pig.*

Kind of guinea pig.	Serum dilution.							
	1:2	1:4	1:6	1:8	1:12	1:16	1:24	1:32
Normal	+	+	—	—	—	—	—	—
Infected	+	+	+	+	+	+	+	—

If the contention is correct that the cercaricidal property is analogous to the bacteriolytic, hæmolytic, and other cytolytic properties of the blood, then like the latter it should be subject to certain immunological processes. That it is is shown by the results of an experiment, the purpose of which was to find out if an increase in the amboceptor content of the blood could be brought about by infecting animals with *Schistosoma japonicum.* Of the two animals used, namely, a guinea pig and a rabbit, the latter unexpectedly died three weeks after it was exposed to the cercariæ, for which reason its serum was not tested. The guinea pig, on the other hand, survived and began passing schistosome ova in its fæces on the forty-second day after it was exposed to the parasite. When its serum was tested, the cercaricidal titer was found to be much higher than that of the serum of a normal guinea pig (Table 4).

SUMMARY

Tests were made to determine the cercaricidal property of the sera of different kinds of vertebrates against two species of larval trematodes; namely, the cercaria of *Schistosoma japonicum* and of *C. maitimensis* Tubangui, 1928. All the sera tested, except those of the cat and the rabbit, possessed marked cercaricidal action against the cercaria of *Schistosoma japonicum.* On *C. maitimensis* the effect was only partial.

The cercaricidal titers of the different sera against the cercaria of *Schistosoma japonicum* varied within appreciably wide limits. The titers of the sera of man, guinea pig, and other warm-blooded vertebrates which are known to serve as favorable hosts to the adult parasite, were found to be uniformly low, while those of the sera of cold-blooded vertebrates that are not susceptible to the parasite were much higher.

The cercaricidal (cercariolytic), bacteriolytic, hæmolytic, and other cytolytic properties of the blood are probably analogous phenomena due to the union of the corresponding antigens with

antibodies of the third order and complement. The fresh normal sera of the cat and the rabbit possess no cercaricidal property, due probably to a deficiency in both amboceptor and complement.

The cercaricidal titer of the serum of a guinea pig infected with *Schistosoma japonicum* was found to be much higher than that of the serum of a normal animal belonging to the same species, due apparently to an increase in the amboceptor content of the blood as a result of the infection.

ACKNOWLEDGMENT

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NOTES ON PHILIPPINE LINGUATULIDS (ARTHROPODA: PENTASTOMIDA)

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THREE TEXT FIGURES

According to Hill (1934), more than fifty species of linguatulids, or tongue worms, have been described from different parts of the world. Only two of these have been recorded from the Philippines; namely, *Armillifer moniliformis* reported by Tubangui (1924) from the reticulated python and the civet cat, and *Alofia travassosi* reported by Heymons (1932) from an unknown host (probably a crocodile) in Samar Island. Recently there were added to the parasitological collection of the Philippine Bureau of Science three representatives of this group of parasites, the identity of which is discussed below.

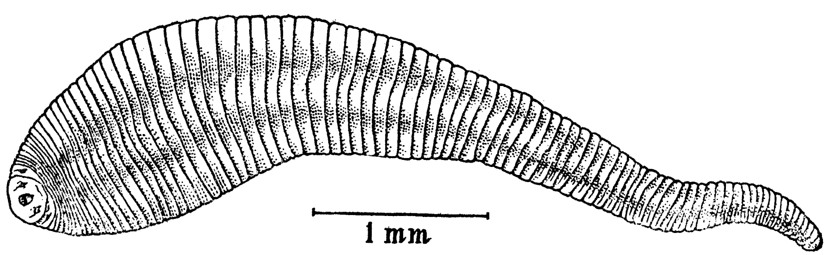

FIG. 1. *Linguatula serrata* Froelich; adult female, entire worm, ventral view.

LINGUATULA SERRATA Froelich, 1789. Text fig. 1.

A single adult female specimen of this tongue worm was received from Dr. M. V. Santiago, who states in a letter that it was coughed out by a dog in Ajuy, Iloilo. The body of the parasite is of characteristic shape, possesses about ninety abdominal segments and measures as follows: Length, 50 millimeters; width near anterior end, 9 millimeters, and at posterior end, 2 millimeters.

The adult form of this parasite has been found in man and in the dog and other carnivores in different parts of the world, and the nymphal stage has been found in man and various species of herbivorous animals.

RAILLIETIELLA AGCOI sp. nov. Text fig. 2.

This linguatulid is named for Mr. Antolin Agco, of the Fish and Game Administration Division, Bureau of Science, who collected several adult female specimens of the parasite from a cobra. Compared with the other members of the genus *Raillietiella* which have been reported from snakes in the Oriental Region, it appears to bear the closest resemblance to *R. orientalis* (Hett, 1915), a parasite of the Indian snakes *Zamensis mucosus* and *Naja tripudians.* It differs from the latter in the following respects: It is smaller and the number of its abdominal rings is less, the maximum being thirty-five. In *R. orientalis* the number of rings is forty or more.

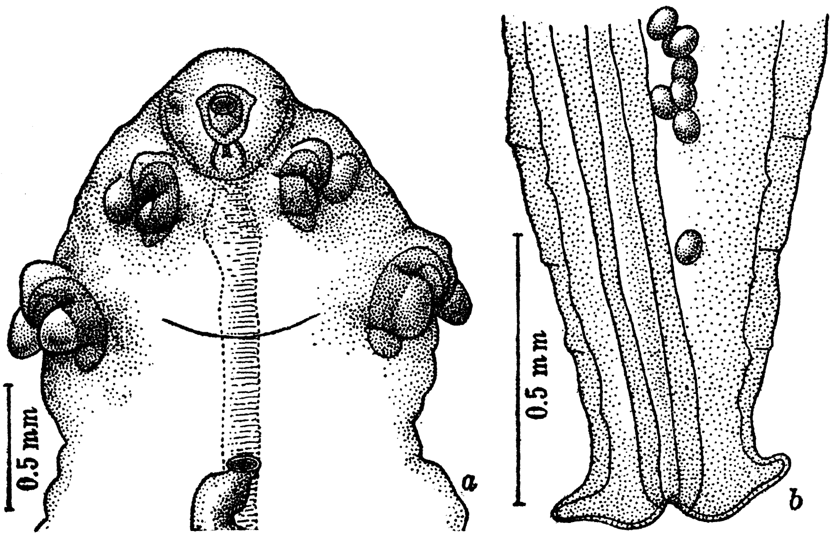

FIG. 2. *Raillietiella agcoi* sp. nov.; *a*, anterior end, ventral view; *b*, posterior end, ventral view.

Description.—Body of adult females slender, gradually tapering towards posterior end, 16 to 39 millimeters long (average length 28 millimeters). Cephalothorax more or less conical, 1.35 to 1.65 by 1.25 to 1.70 millimeters in size. Mouth ventrosubterminal, surrounded by a suckerlike prominence and provided with a distinctive oral armature representing the pharynx. Hooks unequal, arranged in trapezoidal formation, with strongly recurved distal extremities and each surrounded by three vesicular projections that are characteristic of the genus *Raillietiella.* Anterior pair of hooks smaller, 210 to 305 microns long; posterior hooks 285 to 400 microns long. Two other vesicular

projections are found on the dorsal surface of the cephalothorax on a level with the anterior pair of hooks.

Abdomen with thirty-two to thirty-five annulations; terminal segment divided into two divergent lobes, between which is the anal opening.

Uterovagina in the form of a simple sac. Genital opening median, at anterior end of abdomen, 1.25 to 1.65 millimeters from posterior border of mouth. Eggs 99 to 109 by 76.5 to 84.5 microns in size.

Host.—Cobra (*Naja naja philippinensis*).

Location.—Lungs.

Locality.—Cabanatuan, Nueva Ecija, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 473.

PENTASTOMUM SOLARIS sp. nov. Text fig. 3.

This linguatulid is represented in the collection by several immature specimens obtained from the lungs of a crocodile. It is characterized by the presence of an accessory hook on each of the two pairs of principal hooks and of minute spines on the posterior borders of the abdominal rings. According to Hett (1924), these characters represent larval features that are usually thrown off at the last ecdysis during the course of development of this group of parasites.

The parasite bears some resemblance to *Pentastomum gracile*, which, according to Sambon (1922), is probably an immature form of *Leiperia cincinnatis*. The possibility of its being a developmental stage of *Alofia travassosi* should be kept in mind in view of the suspicion of Heymons (1932) that the final host of *A. travassosi* is probably a Philippine crocodile.

Description.—Body cylindrical, rounded at both extremities, 3.5 to 21.5 millimeters in length by 0.6 to 0.8 millimeter in maximum diameter. Cephalothorax small, 0.22 to 0.54 by 0.50 to 0.75 millimeter in size. Mouth ventral, on posterior hook line, in small specimens 0.17 to 0.23 and in the largest specimen 0.44 millimeter from anterior end; oral armature horseshoe-shaped. A pair of papillæ present, one on each side of median line in front of anterior hooks. Hooks unequal, disposed archwise, each with a massive root and an accessory spine; anterior hooks 0.19 to 0.50, posterior hooks 0.20 to 0.60 millimeter long.

Abdomen distinctly annulated, with ninety to one hundred twenty rings; in some specimens lateroventral grooves or lines

are present. Each abdominal ring is provided with a circlet of very minute spines on its posterior border and numerous small openings or stigmata that are usually arranged in a single row near the center of the ring.

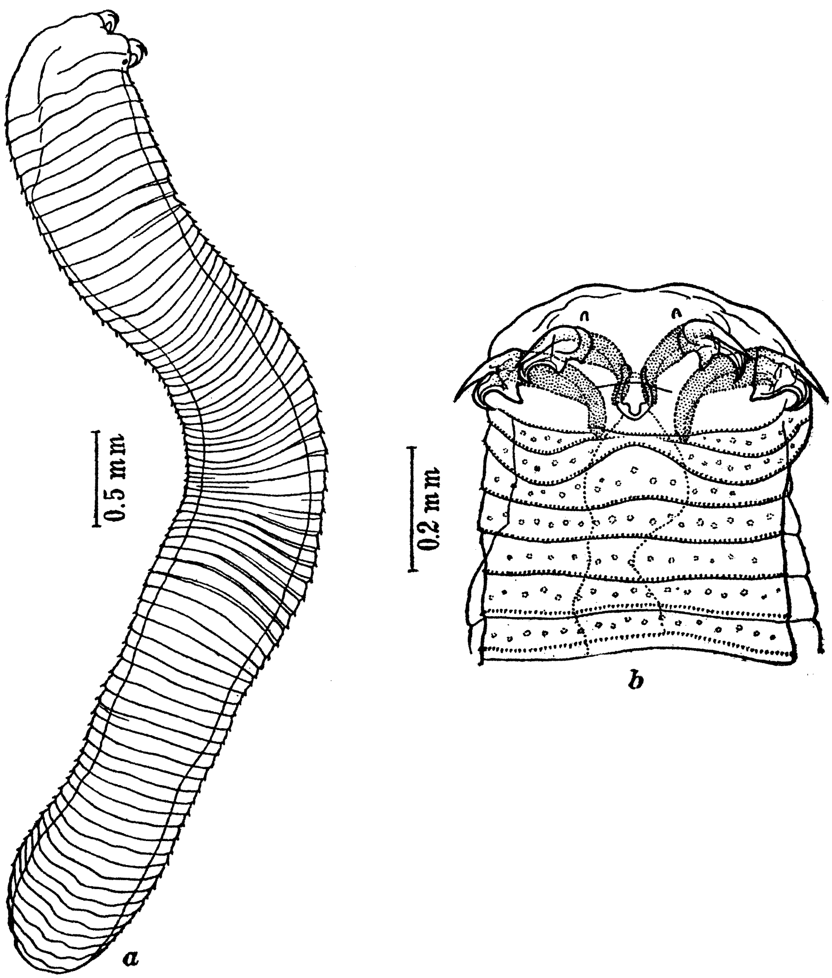

FIG. 3. *Pentastomum solaris* sp. nov., *a*, entire worm, lateral view; *b*, anterior end, ventral view.

Alimentary tract slightly sinuous; anus posteroterminal.

Host.—Crocodile (*Crocodilus porosus*).

Location.—Lungs.

Locality.—Palawan.

Type specimens.—Philippine Bureau of Science parasitological collection, No. 476.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. *Linguatula serrata* Froelich; adult female, entire worm, ventral view.

2. *Raillietiella agcoi* sp. nov.; *a*, anterior end, ventral view; *b*, posterior end, ventral view.

3. *Pentastomum solaris* sp. nov.; *a*, entire worm, lateral view; *b*, anterior end, ventral view.

A REVIEW OF PHILIPPINE PIGEONS, IV
SUBFAMILY DUCULINÆ

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ONE PLATE

The nature and the scope of the present paper are similar to those of the previous numbers of this series. In this paper the subfamily Duculinæ comprises the genera *Ducula, Myristicivora, Ptilocolpa,* and *Zonophaps.* These are large Philippine Columbidæ, distinguished from other forest-inhabiting pigeons of the same size by their under tail coverts, which are slightly, if ever, longer than their toes.

Specimens in the collections of the Agricultural College and of Mr. Moises Villaluz, both in Laguna Province; of Mr. Graciano Castañeda, of Pasay, Rizal Province; and of Mr. Carlos Esperancilla, of Sagay, Occidental Negros, were examined in addition to those in the collection of the Bureau of Science. I wish to express my obligations to these persons for their coöperation. The races reported from the Archipelago but not examined in this study are enumerated but not discussed in this paper.

Key to the Philippine genera of Duculinæ.

a[1]. General color of underparts white .... *Myristicivora.*
a[2]. General color of underparts not white.
  b[1]. Underparts except under tail coverts uniformly gray .... *Ducula.*
  b[2]. Underparts not uniformly gray.
    c[1]. Breast green .... *Zonophaps.*
    c[2]. Breast gray and chestnut .... *Ptilocolpa.*

Genus MYRISTICIVORA Reichenbach, 1852

General color creamy white with wing quills and distal half of most tail feathers slaty black. First and second primaries slightly scooped in their inner web.

One race is known in the Philippines.

MYRISTICIVORA BICOLOR BICOLOR (Scopoli).

Columba bicolor SCOPOLI, Del. Flor. et Faun. Insubr. 2 (1786) 94.

Carpophaga casta PEALE, U. S. Explor. Exped. Mammalogy and Ornithology 8 (1848) 204.

Carpophaga bicolor CASSIN, U. S. Explor. Exped. Mammalogy and Ornithology (1858) 265, pl. 28.

Myristicivora bicolor WALDEN, Trans. Zool. Soc. London 9 pt. 2 (1875) 217.

Myristicivora bicolor bicolor HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 204.

Balabac, Bantayan, Bungau, Cresta de Gallo, Guimaras, Malanipa, Marinduque, Masbate, Mindanao, Mindoro, Negros, Nipah, Palawan, Sakuyok, Sibay, Siquijor, Sulu, Tawitawi, Ticao, and West Bolod.

Specimens from Bantayan, Mindoro, Murcielagos, Palawan, Polillo, Siquijor, and Ticao were examined.

Measurements of Myristicivora bicolor bicolor (Scopoli) based on four males and five females.

	Extremes. mm.	Mean. mm.
Wing	227–239	233.0
Tail	127–135	130.6
Culmen	22–23	22.33
Tarsus	30–32	31.33
Middle toe with claw	44–46	44.4

The material studied from widely separated islands shows uniformity indicating the existence of only one race in the Philippines. According to Hachisuka (1932) the Philippines represents the northeastern range of this subspecies. Chasen (1935) records its occurrence in several islands of Malaysia.

Genus DUCULA Hodgson, 1836

General color of upper parts, except head and neck, largely metallic bluish green; head, neck, and underparts pearly gray or pale vinaceous fawn. Inner web of first primary slightly attenuated.

McGregor and Worcester (1906) recorded six species for the Philippines. Two species with seven subspecies were recorded by Hachisuka (1932).

In this paper the genus is treated with two species grouped into eight subspecies. *D. a. glaucocauda* is described as a new race.

Key to Philippine species of Ducula.

a^1. Upper parts metallic bluish green, under tail coverts chestnut.... *ænea.*
a^2. Upper parts metallic bluish gray, under tail coverts gray.... *pickeringii.*

DUCULA ÆNEA ÆNEA (Linnæus).

Carpophaga ænea GUILLEMARD, Proc. Zool. Soc. London (1885) 270.

Muscadivora ænea MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.

Ducula ænea ænea HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 194.

Bungau, Sulu, and Tawitawi.

No specimen has been examined in this study.

DUCULA ÆNEA CHALYBURA (Bonaparte).

Carpophaga chalybura BONAPARTE, Consp. Gen. Avium 2 (1854) 32.

Carpophaga ænea WALDEN, Trans. Zool. Soc. London 9 pt. 2 (1875) 215.

Carpophaga nuchalis CABANIS, Journ. für Orn. (1882) 126.

Muscadivora ænea MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.

Muscadivora nuchalis MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.

Muscadivores chalybura MCGREGOR, Manual Philippine Birds pt. 1 (1909) 43.

Muscadivores ænea chalybura HACHISUKA, Contrib. Birds Philippines No. 2 (1930) 149.

Ducula ænea chalybura HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 194.

Bantayan, Basilan, Bohol, Camiguin N., Calayan, Catanduanes, Cebu, Dinagat, Fuga, Guimaras, Lubang, Luzon, Marinduque, Mindanao, Mindoro, Negros, Panay, Samar, Semirara, Sibuyan, Siquijor, Tablas, and Ticao.

Specimens from Bantayan, Basilan, Bohol, Camiguin N., Calayan, Cebu, Fuga, Luzon, Mindanao, Mindoro, Negros, Panay, Polillo, Samar, Siquijor, Tablas, and Ticao were examined.

Measurements of Ducula ænea chalybura (Bonaparte) based on twenty-four specimens of each sex.

	Extremes. mm.	Mean. mm.
Wing	232–250	238.52
Tail	143–158	150.31
Culmen	20–22	20.77
Tarsus	32–34	32.71
Middle toe with claw	46–50	48.63

Cabanis (1882) described *Carpophaga* (= *Ducula*) *nuchalis* on the basis of the cupreous chestnut nape of specimens from Luzon. Hachisuka (1932) considers this character of a seasonal nature and regards *nuchalis* as a synonym of *chalybura*. Among nineteen specimens in the collections of the Bureau of Science, of the College of Agriculture, University of the Philippines, and of Moises Villaluz from Luzon, seven birds obtained north of 16° north are distinctly chestnut-naped, while eleven of twelve from south of this latitude are distinct in the absence of that character (Plate 1). These birds were all collected in April, May, and June. This shows that cause for this difference is not of a seasonal nature. With respect to this particular char-

acter the birds from southern Luzon (south of 16° north) resemble those from Mindoro and Polillo. On the other hand, specimens from Samar and Mindanao may, on the basis of this character, be separated from those already mentioned on the basis of a faint trace of chestnut on the nape. The lone specimen from Camarines Sur Province (southern Luzon), however, resembles those from Samar in this character. Until more specimens have been studied, this group of pigeons from Luzon will be regarded as one race.

The sheen on the back, which may be bluish green or brown, is a variable character possessed by specimens from the same locality obtained at the same time.

Only one specimen from Basilan was examined in this study. Its tail measures 143 mm, while 148 mm is the minimum tail length of *D. a. chalybura* from other regions. When sufficient specimens (*Ducula ænea*) are studied from this island, they may be found to belong to the typical race.

DUCULA ÆNEA FUGAENSIS Hachisuka.

Carpophaga nuchalis OGILVIE-GRANT, Ibis VII 2 (1896) 124.
Muscadivora nuchalis MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.
Muscadivores ænea fugaensis HACHISUKA, Contrib. Birds Philippines No. 2 (1930) 150.
Ducula ænea fugaensis HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 196.

Ogilvie-Grant (1896) suspected the male bird that Whitehead collected from Fuga to be a distinct subspecies. Hachisuka (1930) named the lone bird in the collection of the Bureau of Science that was collected by McGregor on Fuga as *Muscadivores ænea fugaensis.* He used its size as the distinguishing criterion, contending that the wing of this bird is 20 mm longer than that of *M. a. chalybura.* Specimens from Calayan and Camiguin in the collection of the Bureau of Science are, in general, larger than *D. a. chalybura* from Luzon as shown in Table 1.

DUCULA ÆNEA GLAUCOCAUDA subsp. nov.

Carpophaga ænea TWEEDDALE, Proc. Zool. Soc. (1879) 832.
Muscadivora ænea MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.
Muscadivores chalybura MCGREGOR, Manual Philippine Birds. pt. 1 (1909) 43.
Ducula ænea chalybura HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 194.

TABLE 1.—*Measurements of D. ænea from the Babuyan group.*

Island.	Catalogue No. and sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe and claw.
		mm.	*mm.*	*mm.*	*mm.*	*mm.*
Calayan	3244 ♂	248	149	23	34	48
Do	3245 ♀	256	156	23	34	51
Do	3059 ♂	253	158	22	34	49
Camiguin	6549 ♂	255	156	22	34	48
Fuga	3038[1] ♂	265	154	21	35	48

[1] Type of *D. a. fugaensis* Hachisuka.

Six specimens from Samar are similar to one from Biliran and seven from Mindanao (Cotabato, Davao, and Surigao). They are, however, distinct from the other birds studied.

Subspecific characters.—Resembling *Ducula ænea chalybura* of southern Luzon, Mindoro, Polillo, Bantayan, Cebu, Bohol, Basilan, Negros, Panay, Siquijor, Tablas, and Ticao, but with upper surface of rectrices appearing as if covered with a fine gray powder. This substance is also distinctly manifest on the upper surface of primaries and secondaries.

Description.—Type, adult male, Bureau of Science collection, No. 29448; Mount Matutum (altitude about 600 meters), Cotabato, Mindanao, April 11, 1932; Francisco Rivera. Edge of forehead creamy white, rest of forehead, crown, occiput and anterior nape pale vinaceous-fawn, rest of nape with trace of light vinaceous-fawn, foreneck pale vinaceous-fawn gradually blending into pale olive-gray of hind neck. Back (dorsum, notæum), wing coverts, and rump metallic bluish green when held towards the light, against a vertical light this color turns to metallic reddish brown. Exposed surface of primaries and secondaries, upper tail coverts and upper surface of rectrices castor gray with an apparent coating of a dawn gray powdery substance that turns to shades between blue and green, depending on its position with regard to the light; sides of head pale vinaceous-fawn; orbital ring creamy white; chin creamy white gradually changing to pale vinaceous-fawn of throat and rest of underparts except thighs which are mineral gray, under tail coverts bay, under surface of rectrices brownish olive with golden sheen.

Measurements of the type.—Wing, 234 mm; tail, 140; culmen, 21; tarsus, 32; middle toe with claw, 44.

In the collection of the Bureau of Science the specimens of this race of imperial fruit pigeon are as follows:

Measurements of Ducula ænea glaucocauda subsp. nov.

Bureau of Science No.	Sex.	Locality.	Date.	Collectors.
29501	♀	Wright, Samar	May 26, 1924	R. C. McGregor et al.
29502	♀	do	May 30, 1924	Do.
29503	♀	do	May 31, 1924	Do.
29504	♀	do	June 4, 1924	Do.
29505	♂	do	June 9, 1924	Do.
29506	♂	do	June 14, 1924	Do.
12385	♀	Butuan, Agusan	Dec. 27, 1907	A. Celestino.
8131	♀	Davao (Mount Galintan)	May 9, 1927	F. Rivera.
29178	♀	Mainit, Surigao	Mar. 17, 1931	A. C. Duyag.
29447	♀	Nupal, Cotabato	Mar. 9, 1932	F. Rivera.
29448	♂	Mount Matutum, Cotabato (type)	Apr. 11, 1932	Do.
29282	♂	do	Apr. 12, 1932	Do.
29449	♂	do	Apr. 12, 1932	Do.
7539	♀	Biliran	May 25, 1914	R. C. McGregor and A. Celestino.

Remarks.—All previous workers regarded this bird as *Ducula ænea chalybura.*

DUCULA ÆNEA PALAWANENSIS (Blasius)

Carpophaga ænea TWEEDDALE, Proc. Zool. Soc. London (1878) 623.
Carpophaga ænea palawanensis BLASIUS, Ornis 4 No. 2 (1888) 316.
Muscadivora ænea MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.
Muscadivores æneus palawanensis OBERHOLSER, U. S. Nat. Mus. Bull. 159 (1932) 27.
Ducula ænea palawanensis HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 195.

Balabac, Calamianes, and Palawan.

Specimens from Balabac, Culion, Linapacan, and Palawan were examined.

Measurements of Ducula ænea palawanensis (Blasius) based on seven males and nine females.

	Extremes. mm.	Mean. mm.
Wing	243–262	248.75
Tail	155–171	163.45
Culmen	20–22	21.06
Tarsus	32–33	32.44
Middle toe with claw	44–48	45.84

This race is distinguished from the other Philippine pigeons of the species *D. ænea* by its deeper glossy bluish green (dusky dull green) on upper surface of rectrices. Generally, the wings

and tail are longer than in other forms, excepting those from Siquijor and Fuga, and some from Calayan and Camiguin. Hachisuka (1932) regards Mindoro, Polillo, and Tablas as ranges for the present race. *D. ænea chalybura* is also considered by him as inhabiting these islands. After an examination of eleven birds from Mindoro, two from Tablas, and two from Polillo, I am convinced that the birds from these islands belong to *D. ænea chalybura.*

DUCULA PICKERINGII PICKERINGII (Cassin).

Carpophaga pickeringii CASSIN, U. S. Explor. Exped. Ornithology (1882) 267.

Muscadivora pickeringii MCGREGOR and WORCESTER, Hand-List Birds Philippine Islands (1906) 11.

Muscadivores pickeringii pickeringii RILEY, Proc. U. S. Nat. Mus. 77 Art. 12 (1930) 7.

Ducula cineracea pickeringii HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 197.

Cagayancillo, Cagayan Sulu, Sibutu, and Sulu.

Specimens from Balabac, Cagayancillo, Cagayan Sulu, Calusa, Cavillé, Lumbucan, and Ursula were examined.

Measurements of twelve males and ten females (2 not sexed) are as follows:

Measurements of Ducula pickeringii pickeringii (Cassin).

	Extremes. mm.	Mean. mm.
Wing	224–241	231.15
Tail	152–175	153.21
Culmen	18–19	18.71
Tarsus	32–34	33.45
Middle toe with claw	40–44	41.88

This race is distinguished by the creamy white frontal edge of forehead and chin and narrow ring of feathers around eye; head and underparts pale vinaceous-fawn, this color gradually changing into gray of head, neck, and mantle; back, including wing coverts, deep mouse gray with a greenish brown tinge; wings dark gray with green tinge on exposed areas; upper surface of tail metallic green, undersurface gray.

DUCULA PICKERINGII LANGHORNEI (Mearns).

Muscadivora langhornei MEARNS, Proc. Biol. Soc. Wash. 18 (1905) 84.

Muscadivores pickeringii langhornei RILEY, Proc. U. S. Nat. Mus. 77 Art. 12 (1930) 7.

Ducula cineracea langhornei HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 197.

Bolod.

No bird of this race has been examined.

DUCULA PICKERINGII PALMASENSIS (Mearns).

Muscadivores palmasensis MEARNS, Proc. U. S. Nat. Mus. 36 (1909) 436.

Muscadivores pickeringii palmasensis RILEY, Proc. U. S. Nat. Mus. 77 Art. 12 (1930) 7.

Ducula cineracea palmasensis HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 198.

Palmas Island in Celebes Sea.

No specimen was examined in this study.

Genus PTILOCOLPA Bonaparte, 1854

First primary attenuated and greatly scooped on middle of its inner web; sexes dissimilarly colored but shade of chestnut dominant in under parts of both.

A monotypic genus confined in the Philippines. Three races are known.

PTILOCOLPA CAROLA CAROLA (Bonaparte).

Carpophaga carola BONAPARTE, Consp. Gen. Avium 2 (1854) 34.

Ptilocolpa carola BONAPARTE, Consp. Gen. Avium 2 (1854) 34.

Ptilocolpa griseopectus WALDEN, Trans. Zool. Soc. London 9 pt. 2 (1875) 216.

Ptilocolpa carola carola HACHISUKA, Contrib. Birds Philippines No. 2 (1930) 151.

Luzon, Mindoro, and Sibuyan.

Specimens from these islands were examined.

Measurements of Ptilocolpa carola carola Bonaparte based on ten males and fifteen females.

	Extremes. mm.	Mean. mm.
Wing	210–221	214.36
Tail	122–136	126.25
Culmen	17–18	17.2
Tarsus	26–27	26.64
Middle toe with claw	40–43	41.13

Male.—Head, nape, back, and interscapular light gull gray; chin creamy white gradually changing to pale gull gray band of throat. Band bordered posteriorly by a white line which forms the anterior border and the arc of a gray semilunar pectoral area. Lower breast, abdomen, and under tail coverts chestnut; flanks gray with impressions of chestnut on their lower border. Except the outer pair, which are yellowish brown with white shafts, the undersurface of the rectrices are black. Wing quills gray with green gloss. Coverts gray, many feathers with a dark spot at tip; rump glossy green with brown mottles; upper tail coverts and upper surface of rectrices glossy bluish green.

Female.—Differs from the male in having a plumbeous head and neck; interscapulars mottled with plumbeous and green glossed with metallic copper red; rest of back with more green impressions; no band on underparts; chestnut lighter.

PTILOCOLPA CAROLA NIGRORUM Whitehead.

Ptilocolpa nigrorum WHITEHEAD, Bull. Brit. Orn. Club 6 (1897) 34.
Ptilocolpa carola nigrorum HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 203.

Negros.

I have not examined birds from this locality.

PTILOCOLPA CAROLA MINDANENSIS Ogilvie-Grant.

Ptilocolpa mindanensis OGILVIE-GRANT, Bull. Brit. Orn. Club 16 (1905) 16.
Ptilocolpa carola mindanensis HACHISUKA, Birds Philippine Islands pt. 2 (1932) 203.

Mindanao.

Six birds from this island (Agusan and Davao Provinces) were examined.

Measurements of Ptilocolpa carola mindanensis Ogilvie-Grant based on two males and four females.

	Extremes. mm.	Mean. mm.
Wing	192–208	197.40
Tail	116–125	119.50
Culmen	16–17	16.60
Tarsus		26.00
Middle toe with claw	37–40	38.00

Resembles closely *P. carola carola*, but male has chin and throat white and pectoral area grayish black.

Genus ZONOPHAPS Salvadori, 1893

Large; bare circumocular area distinct; first and second primaries scooped near middle of their inner webs; tail crossed by a gray band near tip.

Two species and three races were recorded by Hachisuka (1932) in the Philippines.

ZONOPHAPS POLIOCEPHALA POLIOCEPHALA (Gray).

Carpophaga poliocephala GRAY, List Birds Brit. Mus. pt. 3 (Gallinae) (1844) 6.
Hemiphaga poliocephala WALDEN, Trans. Zool. Soc. London 9 pt. 2 (1875) 217.
Carpophaga (Zonophaps) poliocephala SALVADORI, Cat. Birds Brit. Mus. 21 (1893) 207.
Zonophaps poliocephala SHARPE, Hand-List Birds 1 (1899) 65.
Zonophaps poliocephala poliocephala HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 199.

Cebu, Leyte, Luzon, Mindoro, and Panay.

Specimens from Luzon and Mindoro were examined.

Measurements of two females from Luzon are as follows: Wing, 222 mm, 225; tail, 160, 160; culmen 20, 19; tarsus, 26, 28; middle toe and claw, 47, 47.

Hachisuka's *poliocephala* does not have a purplish brown sheen on the back. The birds from Mindoro, according to these two birds from Luzon, should, therefore, be excluded from this race.

ZONOPHAPS POLIOCEPHALA NOBILIS Hachisuka.

Hemiphaga poliocephala SHARPE, Trans. Linn. Soc. London 2d ser. 1 Zoölogy (1875) 347.

Zonophaps poliocephala SHARPE, Hand-List Birds 1 (1899) 65.

Zonophaps poliocephala nobilis HACHISUKA, Birds Philippine Islands 1 pt. 2 (1932) 200.

Basilan, Dinagat, Masbate, Mindanao, Negros, Samar, Sibuyan, and Tawitawi.

Specimens from Basilan, Mindanao, Negros, and Sibuyan were examined.

Measurements of Zonophaps poliocephala nobilis Hachisuka based on three males and ten females

	Extremes. mm.	Mean. mm.
Wing	217–228	222.28
Tail	155–163	160.10
Culmen	19–22	20.27
Tarsus	27–31	27.90
Middle toe with claw	46–48	47.07

The birds from Mindoro should belong to this race which is distinguished from the typical race by the purplish brown sheen on the back.

ZONOPHAPS MINDORENSIS (Whitehead).

Carpophaga mindorensis WHITEHEAD, Ann. & Mag. Nat. Hist. VI 18 (1896) 189.

Zonophaps mindorensis SHARPE, Hand-List Birds 1 (1899) 65.

Mindoro.

I have not examined this species.

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ILLUSTRATION

PLATE 1

Ducula ænea chalybura of northern and southern Luzon showing color difference of the nape.

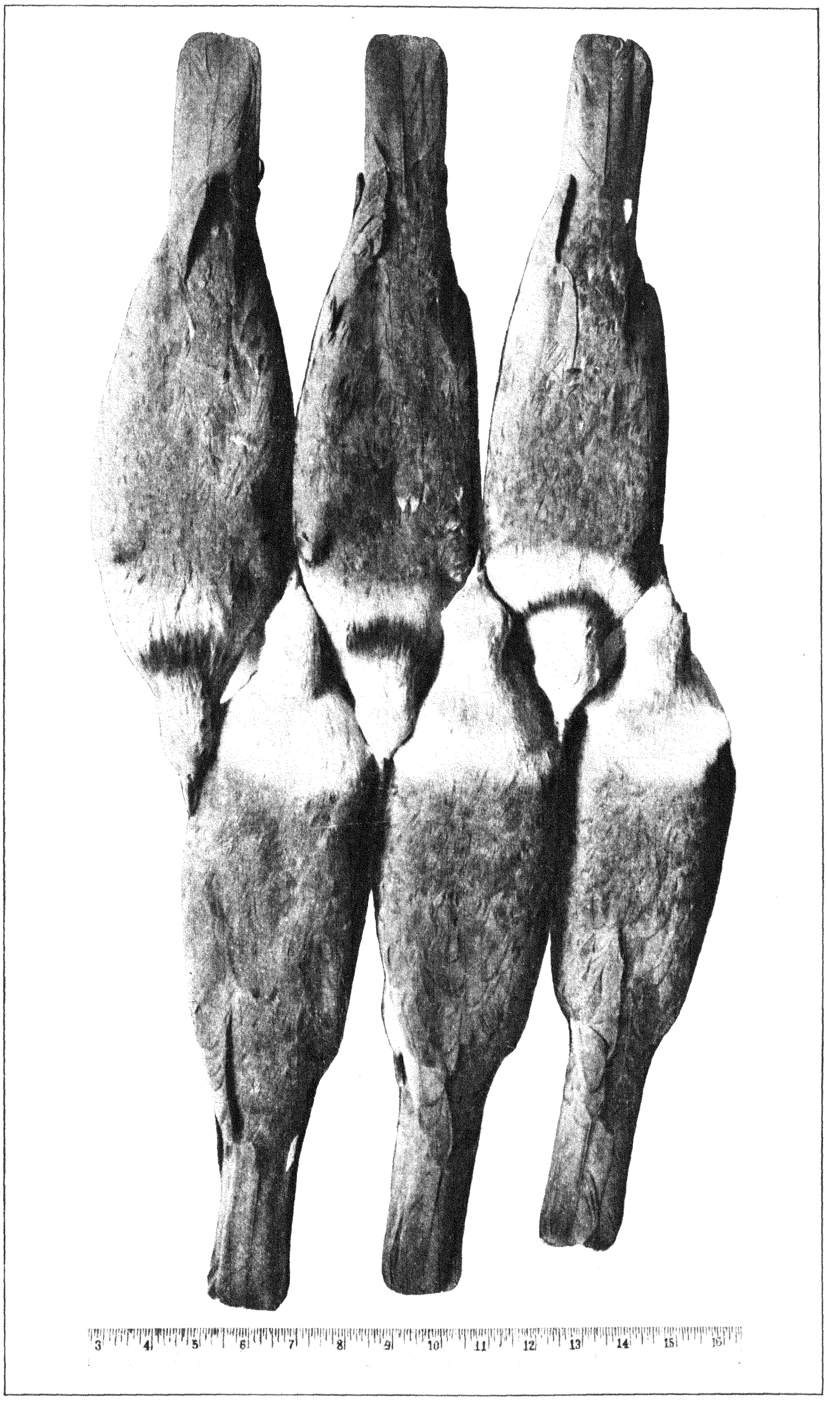


PLATE 1.

NEW OR INTERESTING PHILIPPINE SHELLS

By Godofredo L. Alcasid

Of the National Museum Division, Bureau of Science, Manila

FOUR PLATES

This paper deals with some new or interesting Philippine shells and contains descriptions and figures of three species of shells which have been previously described from extra-Philippine material, but are now reported for the first time in the Philippines. It also records an interesting species recently added to the Bureau of Science collection, previously described but not given any definite Philippine locality. Whenever possible original description, type locality, and distribution will be given.

The writer wishes to acknowledge with thanks the valuable suggestions and assistance given by Mr. Florencio Talavera, of the Fish and Game Administration, Bureau of Science, and to thank Mr. Gregorio A. Lopez for his unfailing enthusiasm in collecting and giving the author whatever interesting material he may encounter.

To the list of references on Philippine shells, the following may be added:

28*b*.[1] H. C. Fulton, in the Proceedings of the Malacological Society 22 (1936) 9, described a new species of *Conus* from Mindoro.

32*a*. In the second series of Pilsbry's Manual of Conchology, there appeared descriptions of several Philippine land shells. Four species of the genus *Strobilops* were given in part 110, pp. 52–56; one species of *Gastrocopta* in part III, p. 120; a list of Philippine Pupillidæ, p. 156.

35*a*. One of the Occasional Papers of the Boston Society of Natural History is Some new land mollusks from Borneo and the Philippines, by William J. Clench and Allen F. Archer 8 (1932) 37–42, pl. 4.

[1] Numbers are those used in the introduction to Bureau of Science Monograph 25; Summary of Philippine land shells, Philip. Journ. Sci. 42 (1930) 85–198; Philippine shells I, Philip. Journ. Sci. 49 (1932) 543–549.

38. In the Nautilus the following papers on Philippine shells were published:

Smith, Maxwell, New Philippine land shells **46** (1932) 62.

McGinty, Thomas L., A new Mindoro land shell **46** (1932) 65; A new Helicostyla from the Philippine Islands **48** (1934) 68.

Goodrich, Calvin, Notes on Philippine fresh-water mollusks **49** (1936) 73.

Family PERNIDÆ Zittel

Genus PEDALION Solander

(*Perna* Bruguière)

PEDALION CUMINGII (Reeve). Plate 1, figs. 1 and 2.

Perna cumingii REEVE, Conchol. Icon. **11** (1859) *Perna* pl. 1, fig. 3.

Pern. testa suborbiculari, latere antico basali producto, crassiusculâ, concentricè, rudè laminatâ, radiatim sulcatâ, laminis subfimbriatis; violaceopurpureô, fusco tinctâ.

Shell somewhat orbicular, basal anterior side produced, rather thick, concentrically rudely laminated, radiately grooved, laminæ slightly frilled; violet-purple, tinged with brown. Habitat.—Australia, *Cuming*.

The basal anterior side of this shell is but very slightly produced and straight, and maintains almost a right angle with the hinge line. The surface is concentrically rudely laminated, the laminæ regularly serrated, producing a frilled appearance and also giving a radiately grooved effect. Violet-purple, tinged with brown with the interior a dark chesnut-brown at the borders, and the middle pearly, brownish purple, iridescent. The muscle scar distinct and central.

This species very closely resembles *P. ephippium* (Linnæus), Plate 1, figs. 3 and 4, but may be distinguished from it by the nearly straight anterior end with the shell generally thinner and the internal coloration very much darker.

Locality.—LUZON, Manila breakwater, *Bur. Sci. 14655 Alcasid.* Attached to rocks and piles by means of a strong byssus.

Family OSTREIDÆ Lamarck

Genus OSTREA Linnæus

OSTREA GLOMERATA Gould. Plates 2 and 3.

Ostræa glomerata Gould, REEVE, Conchol. Icon. **18** (1873) *Ostræa* pl. 22, figs. 52*a*, *b*, *c*, *d*.

Ost. testâ crassâ, irregulari, acuticostatâ, margine dentato vel lobato, valdè inæquivalvi, valva superiori operculari, compressâ, laminis crassis concentricis rugatâ; valva inferiori cucullata, purpureâ, intùs albidâ, purpureo aut nigro marginatâ; marginibus lateribus denticulatìs, cardine plerumque attenuato, producto, acuminato.

Shell thick, irregular, sharp-ribbed, with the margin dentated or lobed, very inequivalve; upper valve opercular, compressed, wrinkled with thick concentric laminæ; lower valve cucullated, purple, white within edged with purple or black; lateral margins denticulated; hinge generally attenuated, produced, pointed.

My specimens are probably immature since they are not very thick and sharp-ribbed. The shells are very inequivalved, the lower valve being deep and cup-shaped, and extending far beyond the flat opercular upper valve. The lateral margins of both valves are denticulated to about two-thirds of the entire length from the hinge. Deep purple without, whitish within and edged with purple or black; the upper valve generally grayish within.

The very young spat of this species are spinose, as in Plate 3, and may be confused with *O. spinosa;* but, as can be seen on subsequent growth, the portion of the mantle that produces the tubular spines later on produces flat foliaceous scales which give it a concentric laminated appearance.

This species was described and reported in the Conchologia Iconica without locality, supposed to have been collected by the Wilkes Expedition.

Locality.—ALABAT, Tayabas Province, *Bur. Sci. 14708 Talavera.* MINDORO, Puerto Galera, *Bur. Sci. 14659 Alcasid.* Attached in clusters to mangroove roots.

Family DOLIIDÆ Adams

Genus PYRULA Lamarck

(*Ficula* Swainson)

PYRULA DUSSUMIERI Valenciennes. Plate 4, figs. 1 and 2.

Pyrula dussumieri Val., KIENER, Iconographie des Coquiles Vivientes, Famille des Canaliferes 2, p. 25, pl. 11; TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 30.

Ficula dussumieri Val., REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 2; SOWERBY, Thes. Conchyl. 4 (1880) 110 *Ficula* pl. 423, fig. 5.

FIC. testâ elongato-pyriformi, gracili, spirâ subexsertâ, liris transversis planodepressis undique cingulatâ, lirarum interstitiis striis longitudinalibus cancellatis; pallidè spadiceâ, strigis rufofuscescentibus undulatis longitudinaliter pictâ, aperturæ fauce spadiceo-fuscescente.

Shell elongately pyriform, slender, with the spire little exserted, encircled throughout with flatly depressed transverse ridges, the interstices between which are cancellated with longitudinal striæ; pale fawn colour, painted longitudinally with waved light rufous brown streaks, interior of the aperture fawn brown.

Habitat.—China, *Cuming.*

This species is chiefly distinguished from its nearest ally, *P. reticulata* Lamarck by its more elongated and slender form together with its longitudinal wavy brown stripes.

Typically an inhabitant of the China Sea and apparently limited to this region.

Locality.—LUZON, Manila Bay, *Bur. Sci. 14660 Lopez.* Collected with beam-trawl nets in water about 40 to 50 feet deep.

Family HYDATINIDÆ Pilsbry

Genus HYDATINA Schumacher

HYDATINA ALBO-CINCTA van der Hoeven. Plate 4, figs. 3 and 4.

Hydatina albo-cincta van der Hoeven, REEVE, Conchol. Icon **16** (1868) *Hydatina* pl. 2, figs. 3*a, b, c;* ANGAS, Proc. Zool. Soc. (1877) 189; TRYON, Man. Conchol. **15** (1893) 388, pl. 45, figs. 29, 30; IWAKAWA, Cat. Jap. Moll. (1919) 168; FAUSTINO, Bur. Sci. Monog. 25 (1928) 348.

Bulla albo-cincta van der Hoeven, SOWERBY, Thes. Conchyl. 2 (1850) 566, pl. 120, figs. 17, 18.

Bulla ferruginosa PERRY, Conchology (1811) pl. 40, fig. 2.

Hyd. testâ subglobosâ, inflatâ tenui, semipellucidâ, fusco-cinerascente, fasciis tribus latis albis radiatâ et striis obliquis, fuscis, numerosis, longitudinalibus pictâ, spirâ retusa, concavâ, aperturâ anticè amplissimâ.

Shell subglobose, inflated, thin, semipellucid, brownish ash-coloured, rayed with three broad white bands, and painted with oblique, brown, numerous, longitudinal striæ, spire retuse, concave; aperture very wide in front.

Habitat.—China, *Cuming.*

The spire of this species is concave; the shell very delicate, covered with a thin, semipellucid, ash-colored epidermis which is finely and obliquely streaked with brown, the streaks interrupted by five sharply defined white bands. Interior white, aperture broadly rounded anteriorly.

Distribution.—China, *Cuming;* Philippines, *Jay;* Japan, *Iwakawa;* Port Stephens, New South Wales, Australia, *Brazzier.*

Locality.—LUZON, Manila Bay, *Bur. Sci. 14661 Lopez.* Collected with beam-trawl nets in water about 40 to 50 feet deep.

ILLUSTRATIONS

Plate 1

FIGS. 1 and 2. *Pedalion cumingii* Reeve.
3 and 4. *Pedalion ephippium* (Linnæus).

Plate 2

FIGS. 1 to 5. *Ostrea glomerata* Gould.

Plate 3

FIGS. 1 and 2. *Ostrea glomerata* Gould, spat. These are the shells shown in Plate 2, figs. 4 and 5, enlarged to show tubular spines.

Plate 4

FIGS. 1 and 2. *Pyrula dussumieri* Valenciennes.
3 and 4. *Hydatina albo-cincta* van der Hoeven.

PLATE 1.

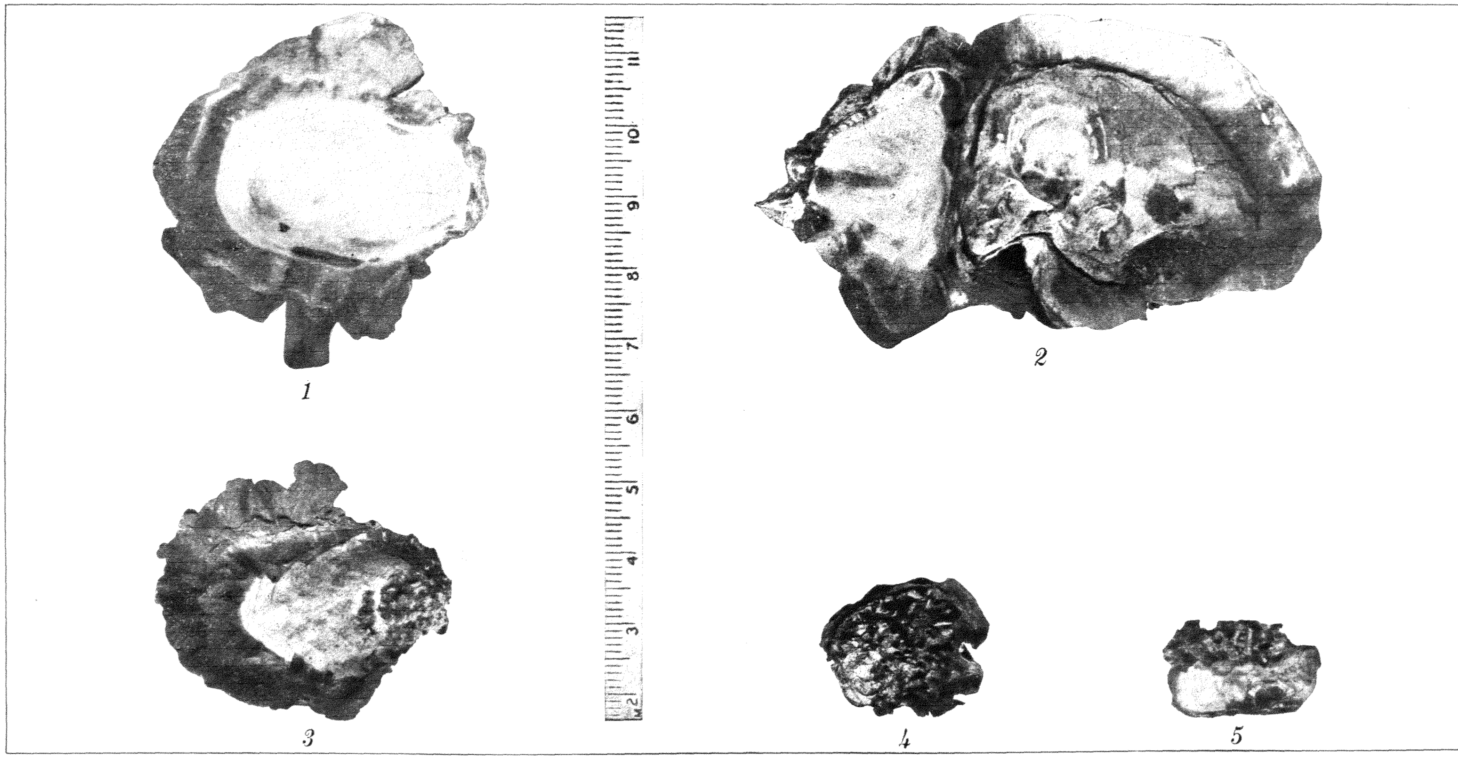


PLATE 2.

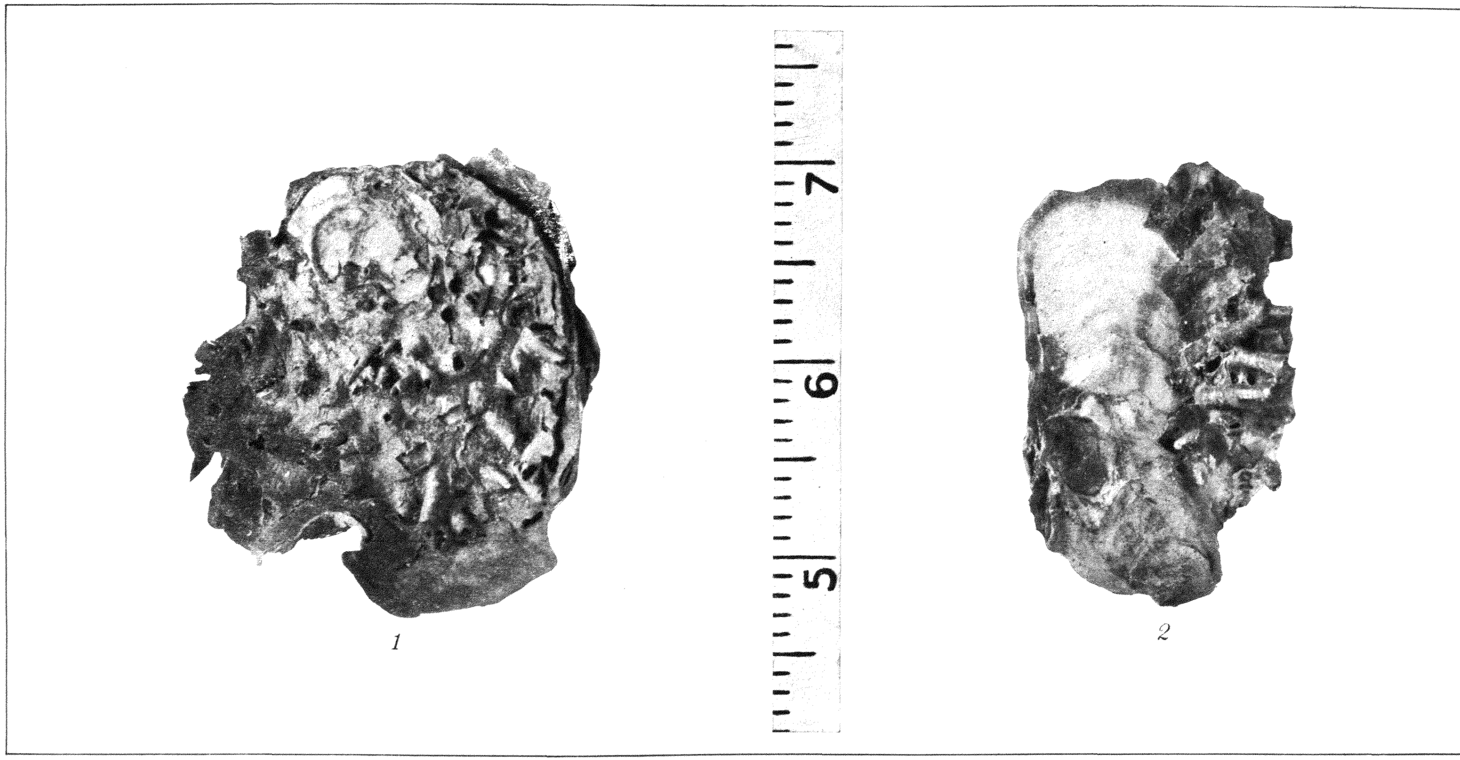
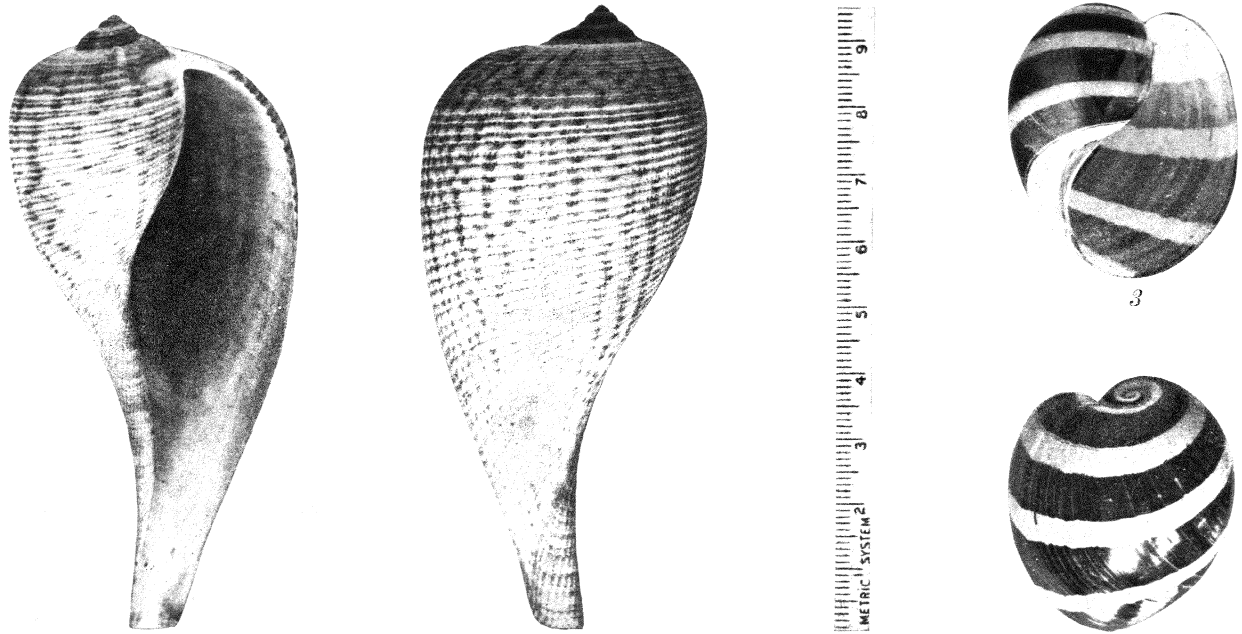


PLATE 3.

[PHILIP. JOURN. SCI., 60, No. 4.



1 2 3 4

PLATE 4.

THYSANOPTERA OF FORMOSA

By RYOICHI TAKAHASHI

Of the Department of Agriculture, Research Institute, Formosa

FOUR TEXT FIGURES

About fifteen years ago I became much interested in the Thysanoptera of Formosa. Since that time I have given my attention to these insects as opportunity permitted, and the results of my observations on the metamorphosis, biology, and economic status of some species have been published.[1] I have scarcely been able, however, to find time for the systematic study of the group, and many of my specimens have been sent for identification to specialists of this group in this country and abroad, and many species have been recorded from my collections by D. Moulton, H. Priesner, and others.

I am convinced that the thrips fauna of the island is fairly well known, and in the present paper an attempt has been made to list all the species now known to occur in the island, with brief biological notes on some of them. Two new species and one new variety are here described.

In this paper ninety-nine species and three varieties are enumerated, which include some that are hitherto unrecorded from Formosa. There are a few species in my collection not yet identified, which are not dealt with here. The food plants given in the following pages are records for Formosa alone.

I am especially indebted to Dr. H. Priesner and Prof. J. D. Hood for their valuable help in determining my specimens, and also to Prof. T. Shiraki for his kind help in various ways.

TEREBRANTIA

THRIPIDÆ

HELIOTHRIPINÆ

RHIPIPHOROTHRIPS PULCHELLUS Morgan.

Rhipiphorothrips pulchellus MORGAN, Proc. U. S. Nat. Mus. 46 (1913) 17; MOULTON, Ann. Zool. Jap. 11 (1928) 288; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1892.

[1] Dobutsugaku Zasshi (Zool. Mag. Tokyo) 35 (1921) 80–85; Botany and Zoology, Tokyo 2 (1934) 1827–1835; Journ. Soc. Trop. Agr. Formosa 7 (1935) 67–78; etc.

Food plant.—*Bischofia javanica.*

Habitat.—Taihoku.

This species is common on the lower sides of the leaves, which show discoloration of both surfaces. Sometimes occurs in large numbers, and the males are much fewer than the females.

HELIOTHRIPS HÆMORRHOIDALIS Bouché.

Heliothrips hæmorrhoidalis Bouché, PRIESNER, Thysan. Europ. 1 (1926) 126; TAKAHASHI, Journ. Soc. Trop. Agr. Formosa 7 (1935) 74; STEELE, Commonwealth Austr., Council for Sci. & Indust. Res., Pamph. 54 (1935) 16; RIVNAY, Bull. Ent. Res. 26 (1935) 267; Bull. Soc. Roy. Ent. Egypte (1935) 119. (Other citations are given in Priesner's and Takahashi's papers.)

Food plants.—*Acacia confusa, Acer* sp., *Alnus formosana, Areca catechu, Bixa orellana, Camellia thea, Cinnamomum camphora, Citrus* spp., *Coffea arabica, Codiaeum variegatum, Cunninghamia lanceolata, Diospyros kaki, Gardenia florida, Glochidion* spp., *Gossypium indicum, Liquidambar formosana, Machilus* sp., *Meliosma rhoifolia, Maesa formosana, Morus alba, Mangifera indica, Myrica rubra, Prunus* spp., *Polygonum* sp., *Quercus variabilis, Rhododendron* sp., *Sideroxylon ferrugineum, Terminalia catappa.*

Habitats.—Throughout the lowlands, and found also in the mountainous regions (Rimogan near Urai, Habon Musha, Kurasu near Hassensan, Fujieda near Rokki).

This species is very common and sometimes occurs in abundance, causing serious damage. It attacks the leaves only and at times is mixed with *Selenothrips rubrocintus* Giard; no male has been detected. Many specimens have been taken on cotton, palm, and *Eugenia,* at Koronya, Ponape Island (Japanese South Sea Islands).

HELIONOTHRIPS BRUNNEIPENNIS Bagnall.

Heliothrips brunneipennis BAGNALL, Ann. & Mag. Nat. Hist. 15 (1915) 318.

Helionothrips brunneipennis BAGNALL, Ann. & Mag. Nat. Hist. 10 (1932) 506.

Food plants.—*Colocasia* sp., *Nicotiana tabacum, Prunus* sp.

Habitats.—Urai near Taihoku (July 2, 1931), Yusho near Piyanan (August 13, 1934), Taihoku (December 5, 1935).

Hitherto unrecorded from Formosa. The Formosan specimens have been compared with a cotype by Prof. J. D. Hood.

HERCINOTHRIPS ERRANS Williams.

Hercinothrips errans WILLIAMS, Entom. 49 (1916) 243; PRIESNER, Thysanop. Europ. 1 (1926) 131; KUROSAWA, Kontyu, Tokyo 4 (1930) 113; PRIESNER, Philip. Journ. Sci. 57 (1935) 351.

Food plants.—*Prunus* sp. and a species of the Lauraceæ.

Habitats.—Taihoku, Kahodai near Hassensan, Suisha.

This species is rather common in the mountainous regions, usually being found in small numbers. It has the habit of jumping from the host when disturbed, and the males are much fewer than the females. Not yet discovered on the Orchidaceæ in Formosa, though known to occur on plants of this family in Europe and Japan.

ASTEROTHRIPS ANGULATUS Hood.

Asterothrips angulatus HOOD, Psyche 32 (1925) 50.

Food plants.—*Agalma lutchuense, Ficus* sp.

Habitats.—Taihoku, Sozan near Taihoku, Rimogan, Kuraru.

New to the fauna of Formosa. My specimens have been kindly determined by Dr. H. Priesner.

SELENOTHRIPS RUBROCINCTUS Giard.

Selenothrips rubrocinctus GIARD, Bull. Soc. Ent. Fr. (1901) 263; TAKAHASHI, Journ. Soc. Trop. Agr. Formosa 7 (1935) 75. (Other literature is cited in Takahashi's paper.)

Food plants.—*Acacia confusa, Alnus formosana, Bixa orellana, Camellia sasanqua, Diospyros kaki, Elaeocarpus elliptica, Eugenia jambos, E. uniflora, Glochidion* sp., *Prunus* sp., *Quercus variabilis, Psidium guajava, Wendlandia glabrata.*

Habitats.—Throughout the lowlands.

Common, sometimes occurring in abundance, but not yet found on cacao in Formosa, though known as a serious pest of it in some countries. At times found in groups with *Heliothrips hæmorrhoidalis* Bouché.

CHIROTHRIPINÆ

CHIROTHRIPS TAKAHASHII Moulton.

Chirothrips takahashii MOULTON, Ann. Zool. Jap. 11 (1928) 289.

Food plants.—*Sorghum* sp., *Miscanthus* sp.

Habitats.—Taihoku, Kahodai near Hassensan, Kurasu.

This species inhabits the flowers, and the specimens collected are females only.

ANAPHOTHRIPINÆ

ANAPHOTHRIPS FLAVICINCTUS Karny.

Anaphothrips flavicinctus KARNY, Bull. Jard. Bot. Buitenzorg II 10 (1913) 55; Bull. Deli Proefst. Sumatra 23 (1925) 24; Revue Russ. Ent. 25 (1933) 174; PRIESNER, Philip. Journ. Sci. 57 (1935) 355.

Food plants.—*Setaria italica, Sorghum* sp. and another plant of the Gramineæ.

Habitats.—Taihoku, Urai near Taihoku, Shinten, Mako (Pescadores Islands).

This species attacks the flowers and leaves, and sometimes occurs in large numbers on sorghum in the Pescadores Islands.

ANAPHOTHRIPS THEIPERDUS Karny.

Anaphothrips theiperdus KARNY, Treubia 2 (1921) 69; PRIESNER, Thysan. Europ. (1928) 205; MOULTON, Ann. Zool. Jap. 11 (1928) 291.

Food plant.—Unknown in Formosa.

Habitat.—Taihoku.

ANAPHOTHRIPS ORCHIDII Moulton.

Anaphothrips orchidii MOULTON, Bur. Ent. U. S. Dept. Agr., Tech. Ser. 12 (1907) 52; PRIESNER, Thysan. Europ. (1928) 204; MOULTON, Ann. Zool. Jap. 11 (1928) 291; Proc. Haw. Ent. Soc. 7 (1928) 107, 132.

Food plant.—*Machilus* sp.

Habitats.—Chikushiko, Sozan near Taihoku.

In Formosa this species is not found on orchids, but feeds on the leaves of the young trees of *Machilus* sp. The leaves are rolled along the margin, with the lower surface in.

SCIRTOTHRIPS DORSALIS Hood.

Scirtothrips dorsalis HOOD, Insec. Inscit. Menst. 7 (1919) 90; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 251; RAMAKRISHNA AYYAR and MARGABANDHU, Journ. Bombay Nat. Hist. Soc. 34 (1931) 1032; PRIESNER, Bull. Soc. Roy. Ent. Egypte (1932) 151, 153.

Food plants.—*Arachis hypogaea, Mangifera indica, Fragaria chiloensis.*

Habitats.—Tainan, Taihoku.

Sometimes occurs in large numbers on leaves, but not so injurious. Near Taihoku sometimes rather common on the upper sides of leaves of strawberry plants in December, and found to breed on the tea plant at Kyoto, Japan, from where it has not been recorded.

THRIPINÆ

AYYARIA CHÆTOPHORA Karny.

Ayyaria chætophora KARNY, Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 193; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 255.

Food plants.—*Glycine, Canavalia,* and other Leguminosæ, and *Gossypium indicum.*

Habitats.—Taihoku, Kyukyokudo near Heito.

This species commonly feeds on the lower sides of leaves of cultivated beans, and many adults are seen on the leaves of cotton. Compared with the holotype by Dr. H. Priesner.

FRANKLINIELLA FORMOSÆ Moulton.

Frankliniella formosæ MOULTON, Ann. Zool. Jap. 11 (1928) 291; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China 3 (1930) 21; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1895.

Food plants.—*Arachis hypogaea, Bauhinia* sp., *Citrus* spp., *Cucumis* sp., *Cucurbita moschata, Gossypium indicum, Ipomoea batatas, Lagerstroemia indica, Luffa cylindrica, Melastoma candidum, Rosa* spp., *Saccharum officinarum, Styrax suberifolium,* and other species.

Habitats.—Taihoku, Shinko, Kyuko near Shinchiku, Tosei, Kagi, Shinka, Tainan, Takao, Heito, Chippon near Taito.

Very common in the flowers of a wide range of plants, but usually very rare on the Gramineæ. The females much outnumber the males.

FRANKLINIELLA GOSSSYPII (Shiraki).

Euthrips gossypii SHIRAKI, Agr. Exp. Sta. Formosa, Special Rept. 5 (1912) 65.

Food plant.—*Gossypium indicum.*

Habitats.—Kagi, Heito.

Closely allied to *F. formosæ* Moulton, but differing in the paler, smaller, and less sclerotized body. Pale yellow, prothorax darker, pterothorax somewhat reddish, abdomen dusky on the apical part. Found in the flowers and on the lower sides of leaves of cotton, while *F. formosæ* Moulton is found in the flowers only.

TÆNIOTHRIPS LEFROYI Bagnall.

Tæniothrips lefroyi BAGNALL, Ann. & Mag. Nat. Hist. VIII 12 (1913) 292; BAGNALL, Bull. Ent. Res. 9 (1918) 63; MOULTON, Ann. Zool. Jap. 11 (1928) 301; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India,

Ent. Ser. 10 (1928) 258; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China 3 (1930) 23; STEINWEDEN, Trans. Am. Ent. Soc. 59 (1933) 282.

Food plants.—*Camellia thea, C. japonica, Styrax suberifolium.*

Habitats.—Taihoku, Hoppo, Gyochi, Chippon near Taito.

Found only in the flowers, common on *Camellia,* and a single male has been taken on *Styrax.*

TÆNIOTHRIPS VARICORNIS Moulton.

Tæniothrips varicornis MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 292; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1895; STEINWEDEN, Trans. Am. Ent. Soc. 59 (1933) 276.

Food plants.—*Luffa cylindrica, Mangifera indica, Persea gratissima.*

Habitats.—Taihoku, Kagi, Kuraru near Koshun.

Very rare in the northern part of the island. Found only in the blossoms.

TÆNIOTHRIPS DISTALIS Karny.

Tæniothrips distalis KARNY, Archiv f. Naturg. 79 (1913) 122; Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 196; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 256; MOULTON, Ann. Zool. Jap. 11 (1928) 297; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China 3 (1930) 23; STEINWEDEN, Trans. Am. Ent. Soc. 59 (1933) 275.

Tæniothrips longistylus KARNY, Journ. Siam Soc. 16 (1923) 99; Bull. Ent. Res. 16 (1925) 126; Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 196; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 258; MOULTON, Ann. Zool. Jap. 11 (1928) 301; STEINWEDEN, Trans. Am. Ent. Soc. 59 (1933) 275; FULLAWAY, Proc. 5th Pacific Sci. Congr. Canada 1933 5 (1934) 3441.

Food plants.—*Crotalaria, Astragalus, Tephrosia, Phaseolus, Vigna, Dolichos, Vicia,* and other Leguminosæ, *Nicotiana tabacum, Ipomoea* sp., *Luffa cylindrica,* and other species.

Habitats.—Throughout the lowlands of Formosa, and some mountainous regions (Urai near Taihoku, Shikikun near Taiheisan, Kurasu near Hassensan, Matsumine near Saramao, Fujieda near Rokki); Botel Tobago (Kotosho).

This species is abundant through the year in the flowers of various legumes, but is found in small numbers on other plants. It has not been detected on the leaves in Formosa, though some were observed attacking the lower sides of the leaves of a bean at Nago, Okinawa, Loochoo, April 27, 1930.

The males appear in any season, but are much fewer than the females. In *T. distalis* the fore femora and the third an-

tennal segment are quite dark, whereas in *T. longistylus* the fore femora are light in color within and the third antennal segment is at least paler than other segments; but there is recognized no morphological difference between them. Moreover, these two are found together in the same flowers in Formosa, the latter form being the commoner.

Many females belonging to the form *longistylus* were collected on *Tephrosia* at Koronya, Ponape Island (Japanese South Sea Islands), August 26, 1933. The species has been known from Fiji and Sunda Islands, but not from Ponape Island.

TÆNIOTHRIPS CLARUS Moulton.

Tæniothrips clarus MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 287; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China **3** (1930) 22; STEINWEDEN, Trans. Am. Ent. Soc. **59** (1933) 281.

Food plant.—*Raphanus acanthiformis.*

Habitat.—Taihoku.

TÆNIOTHRIPS CANAVALIÆ Moulton.

Tæniothrips canavaliæ MOULTON, Ann. Zool. Jap. **11** (1928) 295; STEINWEDEN, Trans. Am. Ent. Soc. **59** (1933) 289.

Food plant.—*Canavalia obtusifolia.*

Habitat.—Botel Tobago (Kotosho).

TÆNIOTHRIPS FORMOSÆ Moulton.

Tæniothrips formosæ MOULTON, Ann. Zool. Jap. **11** (1928) 298; STEINWEDEN, Trans. Am. Ent. Soc. **59** (1933) 276.

Food plant.—*Canavalia obtusifolia.*

Habitat.—Botel Tobago (Kotosho).

TÆNIOTHRIPS KOTOSHOI Moulton.

Tæniothrips kotoshoi MOULTON, Ann. Zool. Jap. **11** (1928) 300; STEINWEDEN, Trans. Am. Ent. Soc. **59** (1933) 284.

Food plant.—*Canavalia obtusifolia.*

Habitat.—Botel Tobago (Kotosho).

TÆNIOTHRIPS GRACILIS Moulton.

Tæniothrips gracilis MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 289; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China **3** (1930) 23; STEINWEDEN, Trans. Am. Ent. Soc. **59** (1933) 272, 283.

Food plant.—One of the Leguminosæ.

Habitat.—Taihoku.

TÆNIOTHRIPS COGNATICEPS Priesner.

Tæniothrips cognaticeps PRIESNER, Stylops 4 (1935) 127.

Food plants.—*Torenia concolor, Languas* sp.

Habitats.—Shinten, Urai, Rarasan, Sozan, Taiheisan, Taroko, Miharashi and Miyama near Chippon, Chushinron near Rokki.

Very common in the mountainous regions; attacks the flowers. A few specimens have been taken in the blossoms of *Melastoma* sp. at Gusuku, Amamioshima, Loochoo.

TÆNIOTHRIPS OREOPHILUS Priesner.

Tæniothrips oreophilus PRIESNER, Philip. Journ. Sci. 57 (1935) 355.

Food plants.—*Torenia concolor* and a plant of the Rosaceæ.

Habitats.—Rarasan, Taiheisan, Muroruafu, Matsumine, Arisan.

Common in the mountainous regions; some specimens were taken at Ubasa, Oita Prefecture, Japan.

TÆNIOTHRIPS SULFURATUS Priesner.

Tæniothrips sulfuratus PRIESNER, Philip. Journ. Sci. 57 (1935) 358.

Food plants.—*Camellia japonica, Clerodendron* sp., *Narcissus tazetta.*

Habitats.—Taihoku, Shinten, Matsumine.

TÆNIOTHRIPS SMITHI (Zimmerman).

Physopus smithi ZIMMERMAN, Bull. Inst. Bot. Buitenzorg 7 (1900) 10.
Tæniothrips smithi STEINWEDEN, Trans. Am. Ent. Soc. 59 (1933) 288; PRIESNER, Philip. Journ. Sci. 57 (1935) 356.

Food plants.—Orchids.

Habitats.—Taihoku, Hori.

Always found in the flowers; common at Hori, central Formosa.

TÆNIOTHRIPS ARALIÆ sp. nov.

Female.—Dirty pale yellow, slightly deeper in color on thorax. Eyes black; ocelli orange-yellow, dark pink on the crescents. First antennal segment pale whitish yellow, second dusky throughout, third dusky, pale whitish yellow on basal and distal parts, fourth dusky except on basal small pale part, fifth to eighth dusky, fifth slightly paler on basal small part. Second to sixth abdominal tergites with a broad, obscure, somewhat pale brown band along anterior margin, which is not well defined on hind border; anterior margins of these tergites narrowly brownish except on lateral part and a very thin transverse gray line behind brownish margin. Legs pale yellow,

tarsi paler, with tips dusky. Wings pale brown, forewings with a very small, indistinct, clear area behind the forevein near base. Prominent setæ on body and wings brownish black. Head slightly wider than long, somewhat constricted behind eyes, slightly arched on cheeks, slightly constricted basally, a little protruding anteriorly, and widely and distinctly divided at front end between antennæ, with some thin, indistinct, transverse striæ on posterior part. Eyes slightly protruding, much narrower than vertex, much longer than half length of cheeks, with some curved setæ, distinctly diverging on the mesal margins except on posterior part; facets large, six, arranged on lateral margin. Ocelli closely placed between posterior halves of eyes, as wide as crescents, posterior ocelli larger than anterior, well separated from eyes, ocellar triangle much wider than long; interocellar bristles very long, very stout, inserted between posterior ocelli, very slightly curved, strongly diverging, as stout as postangular bristles of pronotum, in contact with mesal sides of ocelli, about 0.056 mm long. Postocular setæ short, thin, nearer to eyes than to cheeks, about 0.014 mm long; three similar lateral setæ behind each eye; two pairs of short thin setæ also in front of ocelli; two pairs of very long setæ on anterior part of venter of head. Antennæ about twice as long as head, a little separated from eyes; first segment wider than long; second constricted on basal part, much longer than wide, with six or seven very long setæ; third narrowest at base, broadest on middle swollen part, constricted on distal part, 2.5 times as long as wide, with three or four very long setæ, and a pair of sensory cones which reach basal part of fourth; fourth similar in shape to third, about 2.5 times as long as wide, with three very long setæ and a pair of sensory cones; fifth a little narrowed towards base, not swollen, constricted basally, twice as long as wide, with about four very long setæ which are shorter than those on fourth; sixth about 2.2 times as long as wide, with a simple sense cone arising from about the middle and reaching apex of eighth; seventh as long as wide, narrowed distally; eighth twice as long as wide, 1.5 times as long as seventh; lengths (and widths) of segments as follows: III, 0.069 mm (0.028 mm); IV, 0.065 (0.025); V, 0.037 (0.018); VI, 0.046 (0.021); VII, 0.009 (0.009); VIII, 0.014 (0.007). Pronotum about 1.7 times as wide as long, nearly as long as head, rounded on lateral margin, with rounded corners, hind margin slightly shorter than anterior, with six bristles; over fifty, somewhat curved, rather long setæ scattered

on pronotum except on a pair of large, median, circular areas behind middle, setæ about 0.019 to 0.023 mm long; two setæ on anterior angles, curved, as long as dorsal ones; postangular setæ very long, very stout, pointed, equal in length, about twice as long as median pair of setæ on hind margin, about 0.069 mm long; pterothorax a little wider than pronotum, median bristles on metanotum, far separated from anterior margin, a little curved, about 0.51 mm long. Abdomen broadest on middle, a little wider than thorax, second to eighth tergites with two pairs of setæ, which are much shorter on anterior segments, median pair of setæ on eighth tergite about 0.055 mm long; eighth segment completely set with teeth on hind margin; ninth segment with two pairs of long stout dorsal setæ, two pairs of smaller ventral setæ, and two pairs of long lateral ones, which are longer than segment; tenth segment with two pairs of very long stout setæ, which are shorter than lateral ones on ninth, but longer than dorsal ones on ninth; postangular bristles long, very stout, pointed, a little curved, about 0.069 mm long on sixth segment; sternites without accessory setæ. Wings reaching eighth abdominal segment, forewings with seven basal and two distal setæ on forevein, thirteen setæ on hind vein, and twenty-five setæ on front margin, which are very stout, mostly a little curved, and those on veins about 0.059 mm long; one of the marginal setæ near tip much thinner; double fringe of hairs not observable in my specimen. Legs with many short setæ; femora nearly as long as tibiæ, fore tibiæ about four times as long as wide. Body about 1.5 mm, head about 0.148 mm long, about 0.162 mm wide, antenna about 0.3 mm long, narrowest width of vertex between eyes about 0.069 mm, pronotum about 0.222 mm wide, mesothorax about 0.286 mm wide, fore tibia about 0.16 mm long, lateral bristles (upper pair) on ninth abdominal segment about 0.129 mm long.

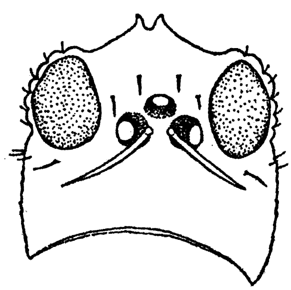


FIG. 1. *Tæniothrips araliæ* sp. nov.; head of adult female.

Food plant.—*Aralia bipinnata.*

Habitat.—Asahi (Taito-cho).

A single specimen was taken by me in the flower, May 16, 1935. This species is characterized by the very large interocellar bristles and the shape of the front of head. In Steinweden's

key to the species of *Tæniothrips* [2] this thrips runs to group II B, but differs from all the species in it, as well as from all species not included in the key. It is easily distinguished from *T. glycines* Okam. by the colors of body and antennæ, the shorter sixth antennal segment, the pale brown wings, the shorter pronotum, and other characters. The type is in the collection of the Department of Agriculture Research Institute, Formosa.

TÆNIOTHRIPS ALLIORUM Priesner.

Tæniothrips alliorum PRIESNER, Stylops 4 (1935) 128.

Food plant.—*Allium fistulosum.*

Habitats.—Taihoku, Heito; Naha, Okinawa, Loochoo.

Common, but occurring in restricted numbers.

THRIPS TABACI Lindeman.

Thrips tabaci Lindeman, KARNY, Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 199; PRIESNER, Thysan. Europ. 3 (1927) 433; TAKAHASHI, Journ. Soc. Trop. Agr. Formosa 7 (1935) 76; STEELE, Commonwealth Austr., Council for Sci. & Indust. Res., Pamph. 54 (1935) 46. (Other citations are given in Priesner's and Takahashi's papers.)

Food plants.—*Allium* spp.

Habitats.—Throughout the lowlands.

In Formosa this species is confined to onions, no specimens having been found on other plants, though the species is extensively polyphagous in other countries. It is very common on the leaves and flowers from April to June near Taihoku and much reduced in numbers during winter; no male has been discovered.

THRIPS FORMOSANUS Priesner.

Thrips formosanus PRIESNER, Natuurkund. Tijdschr. v. Nederl.-Ind. 94 (1934) 283.

Food plants.—*Viola* sp., *Lilium* sp., and other species.

Habitats.—Taiheisan, Niitaka-yama (Mount Morrison). Hinokiyama and Takimi (Takao Prefecture), Izumo (Taito-cho).

Common in the flowers on high mountains.

THRIPS KARNYIANUS Priesner.

Thrips karnyianus PRIESNER, Natuurkund. Tijdschr. v. Nederl.-Ind. 94 (1934) 282.

Food plant.—*Bambusa?*

Habitat.—Naii (Takao Prefecture).

[2] Trans. Am. Ent. Soc. 59: 269.

THRIPS ORYZÆ Williams.

Thrips oryzæ WILLIAMS, Bull. Ent. Res. **6** (1916) 353; KARNY, Journ. Siam Soc. **16** (1923) 109; MOULTON, Ann. Zool. Jap. **11** (1928) 303; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. **10** (1928) 263; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1894; RAMAKRISHNA AYYAR, Agr. & Live-stock India **2** (1932) 395; PRIESNER, Natuurk. Tijdschr. v. Nederl.-Ind. **94** (1934) 289.

Food plants.—*Oryza sativa, Zea mays.*

Habitat.—Taihoku.

Not common, rarely occurring in abundance.

THRIPS HAWAIIENSIS (Morgan).

Euthrips hawaiiensis MORGAN, Proc. U. S. Nat. Mus. **46** (1913) 3.

Thrips hawaiiensis PRIESNER, Natuurk. Tijdschr. v. Nederl.-Ind. **94** (1934) 266.

Tæniothrips hawaiiensis MOULTON, Proc. Haw. Ent. Soc. **7** (1928) 132; STEINWEDEN, Trans. Am. Ent. Soc. **59** (1933) 286.

Thrips albipes BAGNALL, Ann. & Mag. Nat. Hist. VIII **13** (1914) 25; Ent. Month. Mag. **64** (1928) 131; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. **10** (1928) 261; MOULTON, Ann. Zool. Jap. **11** (1928) 302; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China **3** (1930) 24.

Tæniothrips pallipes MOULTON, Ann. Zool. Jap. **11** (1928) 302.

Food plants.—*Acacia confusa, Allium fistulosum, Callicarpa formosana, Camellia* spp., *Citrus* spp., *Aralia* sp., *Castanea* sp., *Clerodendron* spp., *Cirsium* spp., *Chrysanthemum coronarium, Eria nudicaulis, Gardenia florida, Gordonia anomala, Gossypium indicum, Echinochloa crusgalli, Hibiscus rosa-sinensis, H. syriacus, Ipomoea batatas, Jasminum* sp., *Ligustrum japonicum, Lilium* sp., *Luffa cylindrica, Lantana* sp., *Morus alba, Mallotus* spp., *Murraya* spp., *Musa sapientum, Melastoma candidum, Michelia* spp., *Miscanthus* sp., *Nerium indicum, Narcissus tazetta, Nephelium litchi, Psidium guajava, Phoenix hanceana, Passiflora* sp., *Papaver somniferum, Plumiera acuminata, Peucedanum japonicum, Raphanus* sp., *Sansevieria zeylanica, Sambucus* sp., *Saccharum officinarum, Tephrosia* sp., *Vigna* sp., *Zea mays,* etc.

Habitats.—Throughout the lowlands and some mountainous regions (Urai, Kurasu and Kahodai near Hassensan, Funkiko, Asahi and Kakayo, Taito-cho, Habon near Musha, Fujieda near Rokki); Mako, the Pescadores Islands.

This species is the most dominant and polyphagous thrips in Formosa and is common in Loochoo and Japan. It feeds on a very wide range of plants, including the Gramineæ, but has not been found on the Gymnospermæ or the Orchidaceæ. The species attacks the flowers only, and is very injurious to the poppy. The males are as common as the females.

THRIPS FLORUM Schmutz.

Thrips florum SCHMUTZ, Sitzungsber. Kaiserl. Akad. Wissensch. Wien, mathem.-naturw. Klasse 122 (1913) 13; KARNY, Archiv f. Zool. 17 (1924) 13; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 261; Rec. Ind. Mus. 34 (1932) 277; 36 (1934) 493; PRIESNER, Natuurk. Tijdschr. v. Nederl.-Ind. 94 (1934) 261; STEELE, Commonwealth Austr., Council for Sci. & Indust. Res., Pamph. 54 (1935) 39.

Food plants.—*Citrus limonum, Styrax suberifolium.*

Habitats.—Taito, Chippon.

Not common, always inhabiting the flowers.

THRIPS CLARUS Moulton.

Thrips clarus MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 294.

Food plants.—*Allium fistulosum, Bidens pilosa, Cucumis sativus, Cirsium* sp., *Chrysanthemum coronarium, Setaria italica, Ipomoea batatas, Gossypium indicum, Lilium* sp., *Lantana* sp., *Miscanthus* sp., *Polygonum* sp., *Viola* sp., *Zea mays,* various legumes, and other species.

Habitats.—Throughout the lowlands, and some mountainous regions (Chakon near Urai, Rarasan, Shikikun near Taiheisan, Kahodai near Hassensan, Arisan, Funkiko, Musha, Marikowan, Hakku, Kotobuki and Izumo, Taito-cho, Hinokiyama, Takao Prefecture).

Very common; usually found in the flowers, but sometimes attacking the leaves of cotton and the flower buds of the lily.

THRIPS EXTENSICORNIS Priesner.

Thrips extensicornis PRIESNER, Natuurk. Tijdschr. v. Nederl.-Ind. 94 (1934) 276.

Thrips pallipes MOULTON (nec Bagnall), Ann. Zool. Jap. 11 (1928) 303.

Food plants.—*Clerodendron* sp. and a plant of the Compositæ.

Habitats.—Taihoku, Tansui, Shirin, Daiton-san.

Not common, feeding on the flowers.

THRIPS (ISONEUROTHRIPS) ADDENDUS Priesner.

Thrips (Isoneurothrips) addendus PRIESNER, Natuurk. Tijdschr. v. Nederl.-Ind. 94 (1934) 270.

Food plants.—One of the Compositæ, and other species.

Habitats.—Shijukei, Botanwan, Kuraru, Banro.

Common in the flowers of various plants in the southernmost part of the island, but not found elsewhere. The males are common.

THRIPS (ISONEUROTHRIPS) TAIWANUS nom. nov.

Isoneurothrips pallipes MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 296.

Food plant.—A plant of the Leguminosæ.

Habitat.—Hori.

Moulton's name is preoccupied by *Thrips pallipes* Bagnall.

THRIPS (ISONEUROTHRIPS) SETIPENNIS Moulton.

Thrips (Isoneurothrips) setipennis MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 297.

Food plant.—Unknown.

Habitats.—Taihoku, Botel Tobago (Kotosho).

THRIPS (MICROCEPHALOTHRIPS) ABDOMINALIS Crawford.

Thrips abdominalis CRAWFORD, Pomona Coll. Journ. Ent. 2 (1910) 157; WATSON, Florida Agr. Exp. Sta. Bull. 168 (1923) 44.

Microcephalothrips abdominalis BAGNALL, Ann. & Mag. Nat. Hist. IX 18 (1926) 114; MOULTON, Ann. Zool. Jap. 11 (1928) 305; STEINWEDEN and MOULTON, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China 3 (1930) 27; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1893.

Thrips (Ctenothripella) abdominalis MOULTON, Proc. Haw. Ent. Soc. 7 (1928) 110, 132.

Food plants.—*Ageratum conyzoides, Chrysanthemum coronarium,* another plant of the Compositæ, and a plant of the Leguminosæ.

Habitats.—Taihoku, Hichiseisan, Kinpori, Kiirun, Tonroku near Urai; Mako, the Pescadores Islands.

THRIPS (FULMEKIOLA) SERRATUS (Kobus).

Physothrips serratus KOBUS, Meded. Proefst. Oost-Java 43 (1892). (Not available.)

Phloeothrips pallidicornis MATSUMURA (part.), Schäd. u. nützl. Insekt. d. Zuckerrohrs Formosas (1910) 11.

Stenothrips minutus KARNY, Zeits. wiss. Insectenbiol. 11 (1915) 85; MOULTON, Ann. Zool. Jap. 11 (1928) 307; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1893.

Thrips moultoni ISHIDA, Insecta Mats. Sapporo 9 (1934) 55.

Thrips (Saccharothrips) serratus PRIESNER, Natuurk. Tijdschr. v. Nederl.-Ind. 94 (1934) 280.

Food plant.—*Saccharum officinarum.*

Habitats.—Taihoku, Shinka, Tainan, Zenka.

Sometimes occurs in large numbers on the leaves and in the flowers, but is usually less numerous than other species on sugar cane.

ISOCHÆTOTHRIPS QUERCI Moulton.

Isochætothrips querci MOULTON, Ann. Zool. Jap. 11 (1928) 307.

Food plant.—*Quercus* sp.

Habitat.—Taihoku.

BOLACOTHRIPS ORIENTALIS Priesner.

Bolacothrips orientalis PRIESNER, Philip. Journ. Sci. 57 (1935) 359.

Food plant.—*Allium fistulosum.*

Habitat.—Taihoku.

PARABALIOTHRIPS TAKAHASHII Priesner.

Parabaliothrips takahashii PRIESNER, Stylops 4 (1935) 125.

Food plant.—*Liquidambar formosana.*

Habitat.—Kanko near Shinten.

Attacks the lower sides of the leaves.

PARABALIOTHRIPS GRANDICEPS Priesner.

Parabaliothrips grandiceps PRIESNER, Stylops 4 (1935) 126.

Food plant.—*Quercus* sp.

Habitat.—Reimei at Hassensan.

DOCIDOTHRIPS IMITANS Priesner.

Docidothrips imitans PRIESNER, Stylops 4 (1935) 127.

Food plant.—*Psidium guajava.*

Habitat.—Kuraru near Koshun.

TUBULIFERA

PHLŒOTHRIPIDÆ

PHLŒOTHRIPINÆ

GYNAIKOTHRIPS UZELI Zimmerman.

Gynaikothrips uzeli ZIMMERMAN, Bull. Inst. Bot. Buitenzorg 7 (1900) 12; KARNY, Centralbl. f. Bakter., Parasitenk. u. Infektionskr. 30 Abteil. 2 (1911) 561; Marcellina 11 (1912) 129; HOOD, Insec. Inscit. Menstr. 1 (1913) 153; KARNY and LEEUWEN, Bull. Jardin Bot. Buitenzorg 10 (1913) 103; KARNY, Zeits. f. wiss. Insectenbiol. 20 (1915) 327; 21 (1916) 89; TAKAHASHI, Trans. Nat. Hist. Soc. Formosa 12 (1922) 30; KARNY, Treubia 3 (1922) 325; Journ. Siam Soc. 16 (1923) 145; WATSON, Florida Agr. Exp. Sta. Bull. 168 (1923) 68; MOULTON, Ann. Zool. Jap. 11 (1928) 315; RAMAKRISHNA AYYAR and MARGABANDHU, Journ. Bombay Nat. Hist. Soc. 34 (1931) 1040; PRIESNER, Rev. Zool. Bot. Africa 22 (1932) 196; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1829.

Liothrips sp. MAKI, Forest Exp. Sta. Formosa, Spec. Rept. 1 (1915) 16.
Cryptothrips sp. TAKAHASHI, Dobuts. Zasshi (Zool. Mag. Tokyo) 35 (1921) 82.
Gynaikothrips flavus ISHIDA, Insecta Mats. Sapporo 6 (1931) 40.
Gynaikothrips sp. TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1830.

Food plants.—Ficus retusa, F. swinhoei.

Habitats.—Throughout the lowlands; Mako, the Pescadores Islands.

Very common in Formosa and Loochoo on *Ficus retusa,* rolling the leaves. The galls of this species are inhabited by the inquilines *Mesothrips jordani* Zimmerman, *Androthrips ramachandrai* Karny, *Haplothrips inquilinus* Priesner, *Smerinthothrips takahashii* Moulton, and other species.

SMERINTHOTHRIPS VITIVORUS Priesner.

Smerinthothrips vitivorus PRIESNER, Philip. Journ. Sci. 57 (1935) 364.
Gynaikothrips claripennis MOULTON (nec Karny), Ann. Zool. Jap. 11 (1928) 308; ISHIDA, Insecta Mats. Sapporo 6 (1931) 39; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1829.
Gynaikothrips sp. TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1828, 1832.

Food plant.—Vitis shifunensis.

Habitats.—Throughout the lowlands.

This species is common wherever the host plant grows, rolling the leaves; and the galls are invaded by *Haplothrips inquilinus* Priesner.

SMERINTHOTHRIPS LILIACEÆ (Moulton).

Gynaikothrips liliaceæ MOULTON, Ann. Zool. Jap. 11 (1928) 310; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1832.

Food plants.—Smilax spp.

Habitats.—Taihoku, Urai, Shinten, Sekitae, Kannonsan, Hori, Kahodai near Hassensan, Daijurin near Shinsuiei, Kuraru near Koshun.

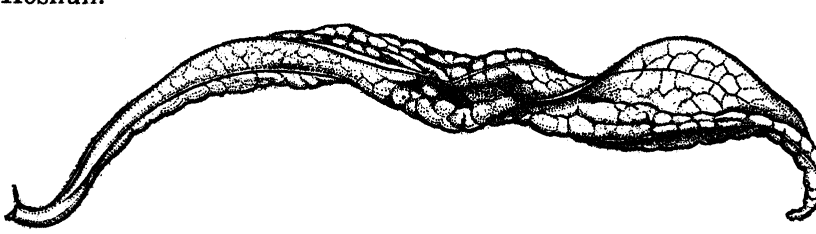


FIG. 2. *Smerinthothrips liliaceæ* Moulton; gall.

This species is very common, rolling the leaves, and is sometimes found with *Smerinthothrips kuwanai* (Moulton) in the galls. Many specimens have been taken on *Smilax* at Iriomote,

Loochoo. The males are common, but usually less numerous than the females.

SMERINTHOTHRIPS YUASAI (Moulton).

Gynaikothrips yuasai MOULTON, Ann. Zool. Jap. **11** (1928) 315.

Food plant.—Unknown.

Habitat.—Domon near Karenko.

SMERINTHOTHRIPS KUWAYAMAI (Moulton).

Gynaikothrips kuwayamai MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 302.

Food plant.—*Viburnum arboricolum.*

Habitats.—Karapin, Koshun.

Found on the lower sides of the leaves.

SMERINTHOTHRIPS SIAMENSIS (Karny).

Gynaikothrips siamensis KARNY, Treubia **3** (1923) 349; Journ. Siam Soc. **16** (1923) 133; Mem. Dept. Agr. India **9** (1926) 236.

Food plants.—*Lithocarpus* sp., *Quercus* sp.

Habitats.—Suisha, Kahodai near Hassensan.

Found in small numbers on the lower surface of the leaves.

SMERINTHOTHRIPS CITRICORNIS (Moulton).

Gynaikothrips citricornis MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 300.

Food plant.—*Liquidambar formosana.*

Habitats.—Taihoku, Shirin.

Attacks the lower surface of the leaves.

SMERINTHOTHRIPS TAKAHASHII (Moulton).

Gynaikothrips takahashii MOULTON, Ann. Zool. Jap. **11** (1928) 313; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1891; Bot. & Zool. Tokyo **2** (1934) 1829.

Food plant.—*Ficus retusa.*

Habitats.—Taihoku, Kikamon near Boryo.

Always found in the galls of *Gynaikothrips uzeli* Zimmerman, being very common in Formosa and Loochoo including Amamioshima.

SMERINTHOTHRIPS KUWANAI (Moulton).

Gynaikothrips kuwanai MOULTON, Ann. Zool. Jap. **11** (1928) 308; TAKAHASHI, Bot. & Zool. Tokyo **2** (1934) 1831.

Mesothrips claripennis TAKAHASHI (nec Moulton), Iconogr. Insect. Japon. (1932) 1890.

Food plants.—*Piper futokadsura, Smilax china, Smilax* sp.

Habitats.—Taihoku, Shinten, Sekitae, Sozan, Urai, Rarasan, Oryukei near Tosei, Habon near Musha, Daijurin near Shin-

suiei, Koshun, Kikamon near Boryo, Kuraru, Chippon, Kowarun, Botanwan, Tachibana (Taito-cho).

This species is very common, especially on *Piper futokadsura*, forming galls on both food plants. Sometimes found associated with *Smerinthothrips liliaceæ* Moulton in the galls on *Smilax*, while the galls on *Piper* are inhabited by the inquilines *Liothrips piperinus* Priesner and *Haplothrips inquilinus* Priesner. The galls on *Smilax* are similar in shape to those of *Smerinthothrips liliaceæ* Moulton.

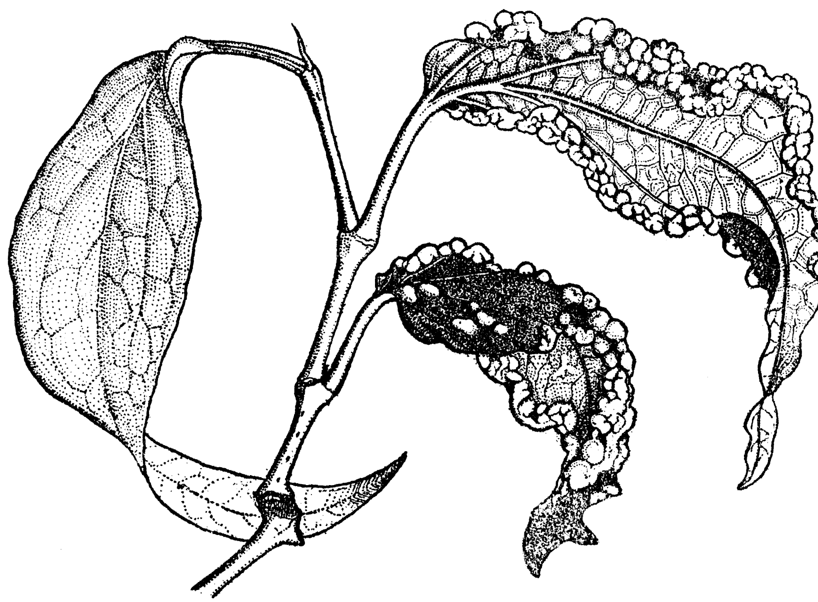


FIG. 3. *Smerinthothrips kuwanai* (Moulton); galls.

NEOSMERINTHOTHRIPS FORMOSENSIS Priesner.

Neosmerinthothrips formosensis PRIESNER, Philip. Journ. Sci. 57 (1935) 368.

Food plant.—Unknown.

Habitats.—Mako, the Pescadores Islands.

LITOTETOTHRIPS ROTUNDUS (Moulton).

Gynaikothrips rotundus MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 304; Ann. Zool. Jap. 11 (1928) 331.

Litotetothrips cinnamomi PRIESNER, Treubia 10 (1929) 4.

Food plant.—*Cinnamomum camphora.*

Habitat.—Taihoku.

Very scarce, occurring in restricted numbers in the buds and on the young shoots.

HOPLOTHRIPS FUNGOSUS Moulton.

Hoplothrips fungosus MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 305.

Food plants.—*Polystictus* sp., and other fungi of the Polyporaceæ.

Habitats.—Taihoku, Kagi, Keiko near Karenko.

Sometimes found mixed with *Hoplothrips japonicus* Karny.

HOPLOTHRIPS JAPONICUS (Karny).

Dorelothrips japonicus KARNY, Archiv f. Naturgesch. 79 Abteil. A (1913) 126; MOULTON, Ann. Zool. Jap. 11 (1928) 330.

Food plants.—Fungi of the Polyporaceæ.

Habitats.—Taiheisan, Keiko near Karenko, Chipponsan, Kuraru.

Sometimes occurs in large numbers, grouping with *Hoplothrips fungosus* Moulton.

HOPLOTHRIPS (ODONTOPLOTHRIPS) DENTIFER Priesner.

Hoplothrips (*Odontoplothrips*) *dentifer* PRIESNER, Philip. Journ. Sci. 57 (1935) 365.

Hoplothrips sp. TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1833.

Food plants.—*Bladhia sieboldii, Clerodendron* sp.

Habitat.—Taihoku.

Found associated with *Mesothrips claripennis* Moulton on *Bladhia,* and in the flowers of *Clerodendron.* Also taken at Nishinakama, Amamioshima, Loochoo.

CRYPTOTHRIPS MAGNUS Moulton.

Cryptothrips magnus MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 299; Ann. Zool. Jap. 11 (1928) 329.

Food plant.—Unknown.

Habitat.—Kotosho (Botel Tobago).

CRYPTOTHRIPS SAUTERI Karny.

Cryptothrips sauteri KARNY, Suppl. Ent. 2 (1913) 127; MOULTON, Ann. Zool. Jap. 11 (1928) 330.

Food plant.—Unknown.

Habitat.—Kankau.

LIOTHRIPS PIPERINUS Priesner.

Liothrips piperinus PRIESNER, Philip. Journ. Sci. 57 (1935) 361.

Food plant.—*Piper futokadsura.*

Habitats.—Rarasan near Urai, Habon near Musha, Chippon, Botanwan.

Always found in the galls of *Smerinthothrips kuwanai* Moulton, but in far fewer numbers than the host species.

LIOTHRIPS FLORIDENSIS (Watson).

Cryptothrips floridensis WATSON, Ent. News **24** (1913) 145; **26** (1915) 52; Florida Agr. Exp. Sta. Bull. **168** (1923) 69, 70; MOULTON, Ann. Zool. Jap. **11** (1928) 329.
Liothrips floridensis WATSON, Florida Ent. **9** (1925) 39.

Food plant.—*Cinnamomum camphora.*

Habitat.—Taihoku.

In Formosa this species is very scarce, being found singly or in very small numbers on the distal ends of the young shoots or in the leaf buds; however, it is very injurious in Florida, North America.

LIOTHRIPS BREVITUBUS Karny.

Liothrips brevitubus KARNY, Marcellia **11** (1912) 156; TAKAHASHI, Bot. & Zool. **2** (1934) 1829.
Liothrips malloti MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 308; Ann. Zool. Jap. **11** (1928) 332; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1891.

Food plant.—*Mallotus repandus.*

Habitats.—Taihoku, Kannonsan, Daitonsan, Tosei, Rokki.

Very common, shrinking the leaves; sometimes preyed upon by *Hoplothrips inquilinus* Priesner. The Formosan specimens have been compared with the type specimen by Dr. H. Priesner.

LIOTHRIPS BREVITUBUS Karny var. FLAVICORNIS Moulton.

Liothrips brevitubus Karny var. *flavicornis* MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 310.

Food plant.—Unknown.

Habitat.—Taihoku.

LIOTHRIPS HEPTAPLEURINUS Priesner.

Liothrips heptapleurinus PRIESNER, Philip. Journ. Sci. **57** (1935) 360.

Food plant.—*Heptapleurum* sp.

Habitat.—Taihoku.

LIOTHRIPS TERMINALIÆ Moulton.

Liothrips terminaliæ MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 311; Ann. Zool. Jap. **11** (1928) 332.

Food plant.—*Terminalia catappa.*

Habitat.—Koshun.

RHYNCHOTHRIPS (?) MACHILI Moulton.

Rhynchothrips (?) *machili* MOULTON, Trans. Nat. Hist. Soc. Formosa **18** (1928) 313.

Food plant.—*Machilus* sp.

Habitat.—Tattaka near Musha.

DOLICHOTHRIPS FLAVIPES (Moulton).

Neoheegeria flavipes MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 317.

Food plant.—*Euphorbia* sp.

Habitat.—Taihoku.

DOLICHOTHRIPS MACARANGAI (Moulton).

Neoheegeria macarangai MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 319; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1889.

Food plant.—*Macaranga tanarius.*

Habitats.—Taihoku, Takao.

Very common, occurring in large numbers in the flowers and among the buds.

DOLICHOTHRIPS PUMILIS Priesner.

Dolichothrips pumilis PRIESNER, Philip. Journ. Sci. 57 (1935) 362.

Food plant.—*Diospyros discolor.*

Habitat.—Nisui.

Attacks the lower sides of the leaves.

PLECTROTHRIPS CORTICINUS Priesner.

Plectrothrips corticinus PRIESNER, Philip. Journ. Sci. 57 (1935) 371.

Habitat.—Taihoku.

Found under the bark of decayed trees.

MESOTHRIPS JORDANI Zimmerman.

Mesothrips jordani ZIMMERMAN, Bull. Inst. Bot. Buitenzorg 7 (1900) 16; KARNY, Journ. Siam Soc. 16 (1923) 145; PRIESNER, Treubia 10 (1929) 453; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1830.

Food plant.—*Ficus retusa.*

Habitats.—Shoka, Gaishatei, Tosei, Nisui, Tainan, Takao, Heito, Daibu.

Always found in the galls of *Gynaikothrips uzeli* Zimmerman; common in the south part of the island but absent in the north. The thrips recorded under the name *Mesothrips pyctes* var. *debilis* Karny, by Moulton,[3] from Formosa, may be this species.

MESOTHRIPS ALLUAUDI Vuillet.

Mesothrips alluaudi VUILLET, Bull. Soc. Ent. France 1914 (1914) 211; MOULTON, Ann. Zool. Jap. 11 (1928) 319.

Food plant.—*Machilus* sp.

Habitat.—Taihoku.

[3] Ann. Zool. Jap. 11 (1928) 318.

MESOTHRIPS CLARIPENNIS Moulton.

Mesothrips claripennis MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 315; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1833.

Food plant.—*Bladhia sieboldii.*

Habitats.—Taihoku, Sozan, Kannonsan. Also found in Amamioshima, Loochoo.

This species is common, rolling the leaves. The galls are invaded by *Hoplothrips inquilinus* Priesner and *Hoplothrips dentifer* Priesner.

ANDROTHRIPS RAMACHANDRAI Karny.

Androthrips ramachandrai KARNY, Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 226; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 301; MOULTON, Ann. Zool. Jap. 11 (1928) 318; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1830.

Food plant.—*Ficus retusa.*

Habitats.—Nisui, Tainan.

Found associated with *Gynaikothrips uzeli* Zimmerman.

HAPLOTHRIPS GOWDEYI Franklin.

Haplothrips gowdeyi FRANKLIN, Proc. U. S. Nat. Mus. 32 (1908) 724; HOOD, Insec. Inscit. Menstr. 1 (1913) 149; Mem. Queensland Mus. 6 (1918) 127; WATSON, Florida Agr. Exp. Sta. Bull. 168 (1923) 60; MOULTON, Ann. Zool. Jap. 11 (1928) 319; Proc. Hawaii. Ent. Soc. 7 (1928) 125, 134; PRIESNER, Bull. Soc. Roy. Ent. Egypte 1929 4 (1929) 216; 1930 4 (1931) 261; Record. Ind. Mus. 35 (1933) 354; MOULTON, Bishop Mus. Bull. 113 (1935) 31.

Food plants.—*Ageratum* sp., *Allium fistulosum, Aster lauruleanus, Bidens pilosa, Celosia* spp., *Chrysanthemum* sp., *Cirsium* sp., *Clerodendron* sp., *Cyperus* sp., *Emilia sonchifolia, Gossypium indicum, Lantana camara, Lactuca debilis, Melastoma candidum, Oenanthe* sp., *Osmanthus fragrans, Rubus illecebrosus, Zea mays,* and other species.

Habitats.—Throughout the lowlands; the Pescadores Islands.

Very common in the flowers of various plants.

HAPLOTHRIPS ACULEATUS Fabricius.

Haplothrips aculeatus Fabricius, PRIESNER, Thysan. Europ. (1928) 597; MOULTON, Ann. Zool. Jap. 11 (1928) 319; Record. Ind. Mus. 35 (1933) 366; BAGNALL, Ann. & Mag. Nat. Hist. X 11 (1933) 326.

Phloeothrips pallidicornis MATSUMURA (part.), Schaedl. u. nuetzl. Insekt. d. Zuckerrohrs Formosas (1910) 11.

Phloeothrips pallicornis MATSUMURA, Mem. Soc. Ent. Belg. 18 (1911) 133.

Haplothrips pallicornis MOULTON, Ann. Zool. Jap. 11 (1928) 334.

Food plants.—*Allium fistulosum, Celosia argentea, Cyperus* sp., *Hibiscus rosa-sinensis, Setaria italica, Miscanthus* sp., *Oryza*

sativa, Saccharum officinarum, Sorghum sp., *Spinacia oleracea, Zea mays,* and other species.

Habitats.—Taihoku, Hokuto, Shinten, Kagi, Shinka, Zenka, Heito.

Common on sugar cane, at times occurring in large numbers, but scarce on rice; always in the flowers.

HAPLOTHRIPS GANGLBAUERI Schmutz.

Haplothrips ganglbaueri SCHMUTZ, Sitzgsbericht. Akad. Wiss. Wien (1913) 1034; KARNY, Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 217; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 292; PRIESNER, Records Ind. Mus. 35 (1933) 355.

Food plants.—*Setaria italica, Cyperus* sp., *Miscanthus* sp., and another plant of the Gramineæ.

Habitats.—Taihoku, Shinten, Ikenohata near Bonbonsan, Hakumo near Tosei, Kahodai near Hassensan.

HAPLOTHRIPS CHINENSIS Priesner.

Haplothrips chinensis PRIESNER, Record. Ind. Mus. 35 (1933) 359.
Haplothrips subtilissimus f. *floricola* MOULTON (nec Priesner), Ann. Zool. Jap. 11 (1928) 320.

Food plants.—*Ageratum* sp., *Astragalus sinicus, Allium fistulosum, Bidens pilosa, Bladhia sieboldii, Castanea* sp., *Cirsium* sp., *Clerodendron* sp., *Citrus* spp., *Camellia* spp., *Canna* sp., *Crotalaria saltiana, Chrysanthemum* sp., *Cryptotaenia canadensis, Gossypium indicum, Ipomoea batatas, Jasminum* sp., *Lactuca debilis, Luffa cylindrica, Eria nudicaulis, Murraya* sp., *Morus alba, Nephelium litchi, Narcissus tazetta, Oenanthe* sp., *Oxalis violacea, Prunus* sp., *Polygonum* sp., *Pueraria thunbergiana, Rumex* sp., *Rosa* sp., *Rubus* sp., *Raphanus* sp., *Trifolium repens,* etc.

Habitats.—Taihoku, Hichiseisan, Taiheisan, Urai, Shikikun, Suigen near Rato, Tonroku near Urai, Kyuko near Shinchiku, Hakku near Musha, Inrin, Kagi, Arisan, Tainan, Taito, Taroko; Botel Tobago (Kotosho); the Pescadores Islands.

Very common in the flowers; the Formosan specimens have been examined by Dr. H. Priesner. *Haplothrips subtilissimus* Haliday does not exist in Formosa.

HAPLOTHRIPS CHINENSIS Priesner var. MONTIVAGUS Priesner.

Haplothrips chinensis Priesner var. *montivagus* PRIESNER, Philip. Journ. Sci. 57 (1935) 366.

Food plants.—*Polygonum* spp., *Callicarpa formosana.*

Habitats.—Taihoku, Urai, Taiheisan, Taroko, Kahodai near Hassensan, Arisan, Marikowan near Musha, Aderu and Budai near Heito, Torin (Taito-cho).

Very common in the flowers of *Polygonum*, especially in the mountainous regions.

HAPLOTHRIPS CERTUS Priesner.

Haplothrips certus PRIESNER, Treubia 9 (1929) 194; Record. Ind. Mus. 35 (1933) 353.

Haplothrips formosæ TAKAHASHI, Iconogr. Insect. Japon. (1932) 1890.

Food plants.—*Cyperus* sp. and a plant of the Leguminosæ.

Habitats.—Taihoku, Shinten, Takao; Botel Tobago (Kotosho).

Rather common in the flowers of *Cyperus*. The Formosan specimens have been compared with the types by Dr. H. Priesner.

HAPLOTHRIPS VERNONIÆ Priesner.

Haplothrips ceylanicus var. *vernoniæ* PRIESNER, Treubia 2 (1921) 4, 7; Bull. Deli Proefst. 23 (1925) fig. 17; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 292.

Haplothrips vernoniæ PRIESNER, Record. Ind. Mus. 35 (1933) 360.

Food plants.—*Cucumis sativus, Callicarpa formosana, Celosia cristata, Gossypium indicum, Ipomoea batatas, Lagerstroemia indica, Melastoma candidum, Pleuropterus hypoleucus, Pueraria thunbergiana,* and other species.

Habitats.—Taihoku, Shinten, Taroko, Kahodai near Hassensan, Heito.

HAPLOTHRIPS VERNONIÆ Priesner var. GRANDIOR Priesner.

Haplothrips vernoniæ Priesner var. *grandior* PRIESNER, Record. Ind. Mus. 35 (1933) 361.

Food plants.—*Cirsium* sp., *Lactuca scariola, Momordica charantia.*

Habitat.—Taihoku.

HAPLOTHRIPS ALLII Priesner.

Haplothrips allii PRIESNER, Philip. Journ. Sci. 57 (1935) 367.

Food plant.—*Allium fistulosum.*

Habitat.—Sankaiseki near Takao.

Very rare.

HAPLOTHRIPS LEUCANTHEMI Schrank.

Haplothrips leucanthemi Schrank, PRIESNER, Thysan. Europ. (1928) 614.

Food plant.—*Ficus retusa.*

Habitat.—Mako, the Pescadores Islands (June 4, 1930).

New to the fauna of Formosa. Many specimens were taken on a composite at Kaibato, Saghalien, by Dr. T. Shiraki, July 1930.

At Mako this species was found with *Gynaikothrips uzeli* Zimmerman in the rolled leaves.

HAPLOTHRIPS INQUILINUS Priesner.

Haplothrips inquilinus PRIESNER, Treubia 2 (1921) 4, 6; KARNY, Mem. Dept. Agr. India, Ent. Ser. 9 (1926) 216; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. 10 (1928) 292; PRIESNER, Record. Ind. Mus. 35 (1933) 349; TAKAHASHI, Bot. & Zool. Tokyo 2 (1934) 1830; RAMAKRISHNA AYYAR, Record. Ind. Mus. 36 (1934) 496.

Habitats.—Taihoku, Daitonsan, Sozan, Matsumine near Saramao, Hori, Taito.

This species is predatory, being found in the galls of other thrips on *Piper futokadsura, Bladhia sieboldii, Mallotus repandus, Vitis shifunensis,* and *Ficus retusa,* but not in those on *Smilax.* Very common, especially on *Piper.*

HAPLOTHRIPS FUSCIPENNIS Moulton.

Haplothrips fuscipennis MOULTON, Ann. Zool. Jap. 11 (1928) 320.

Habitat.—Taihoku.

Found in the galls of *Smerinthothrips kuwanai* (Moulton) on *Piper futokadsura.*

ALEURODOTHRIPS FASCIAPENNIS (Franklin).

Cryptothrips fasciapennis FRANKLIN, Proc. U. S. Nat. Mus. 33 (1908) 727.

Aleurodothrips fasciapennis MOULTON, Ann. Zool. Jap. 11 (1928) 322; TAYLOR, Bull. Ent. Res. 26 (1935) 53.

Habitats.—Taihoku, Kosuiko near Tainan.

This species is predatory and is found on *Citrus, Osmanthus,* and *Bischofia.* Very scarce.

LEEUWENIA PUGNATRIX Priesner.

Leeuwenia pugnatrix PRIESNER, Philip. Journ. Sci. 57 (1935) 373.

Leeuwenia indicus TAKAHASHI (nec Bagnall), Iconogr. Insect. Japon. (1932) 1888.

Food plant.—*Lithocarpus* sp.

Habitats.—Hori, Suisha.

Found on the lower sides of the leaves.

LEEUWENIA TAIWANENSIS sp. nov.

Female.—Black; first antennal segment somewhat brownish black, second yellow, blackish especially on basal half, third pale yellow, slightly deeper in color on distal widened part, fourth and fifth similar in color to third, but deeper in color on distal part, sixth pale yellow, darker and shaded with pale gray on

distal part, seventh yellow, dusky on distal half, eighth somewhat yellowish dusky; femora black; fore tibiæ blackish yellow except on distal yellow part, middle and hind tibiæ black except on distal one-third or one-fourth, which is yellow; tarsi yellow, dusky on distal half; bladders blackish yellow; wings pale brown; setæ on head dusky, but those on posterior angles of abdominal segments pale yellowish.

Head including frontal produced part about 1.4 times as long as wide, straight and parallel on sides, very slightly narrowed at base, not constricted behind and across eyes, distinctly but only a little notched behind eyes; cheeks lacking granules and warts, nearly twice as long as eyes, with about seven to ten short spinelike setæ which are about 0.023 mm long, irregularly arranged except on about basal third; vertical reticulations reaching a little behind posterior ocelli, but not postocellar setæ; postocular bristles short, about 0.042 mm long, pointed, distinctly apart from cheeks, a little nearer to cheeks than to the eyes, not reaching eyes; postocellar setæ short, about 0.025 mm long, thin, slightly curved, reaching posterior ocelli, a little nearer to eyes than to ocelli, some small dorsal setæ present except on posterior part. Eyes not protruding, narrower than vertex, nearly parallel on mesal margins, but slightly diverging anteriorly. Ocelli nearly equidistant, anterior ocellus directed forward, nearly reaching bases of antennæ; posterior ocelli in contact with eyes, a little smaller in diameter than distance between themselves, just anterior to a line drawn across the middle of eyes. Mouth parts reaching slightly beyond middle of prothorax, pointed. Antennæ rather slender, first segment wider than long, second much longer than wide, cylindrical, third widely but shallowly indented at middle of mesal side, third to sixth clavate, gradually widened distally, seventh gradually narrowed on basal part, slightly so at apex, eighth not narrowed basally, lengths (and widths) of segments about as follows: III, 0.134 mm (0.042 mm), IV, 0.125 (0.046); V, 0.125 (0.042); VI, 0.115 (0.042); VII, 0.078 (0.032); VIII, 0.051 (0.018). Pronotum much shorter than head, not well reticulated, about 1.8 times as wide as long, with many small setæ, and very stout antero- and postangular bristles and a lateral similar bristle at about middle, the bristles subequal in length, pointed, very slightly narrowed basally, rather short, about 0.048 mm long, usually

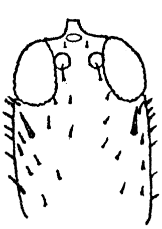


FIG. 4. *Leeuwenia taiwanensis* sp. nov.; head.

very slightly curved on distal part; two short thin setæ near anterior margin, much longer than other dorsal setæ, much smaller than angular bristles, and much nearer to angular bristles than to each other. Pterothorax somewhat wider than abdomen, metanotum reticulated on median area of posterior half. Fore coxæ with a very stout seta similar to, but slightly shorter than, angular bristles of pronotum. Abdomen broadest at base, gradually tapering; first tergite triangular, wider than long, second distinctly reticulated on median area, second to eighth transversely reticulated and with many setæ in a group on lateral area, and some small setæ on the median area; postangular setæ of segments stout, pointed, very slightly narrowed basally, stouter than curved dorsal setæ, erect, much shorter than segments, outer ones on seventh segment about 0.096 mm long, dorsal setæ on lateral area of second about 0.03 mm long; tube long, but much shorter than remaining part of abdomen, as long as second to fourth segments taken together, broadest at base, a little tapering, eight times as long as wide at base, not swollen, slightly constricted at apex, sparsely beset with many thin setæ, which are directed posteriorly, slightly curved, as long as width of apex of tube, none on basal and distal small parts, about ten of them discernible along side. Wings nearly reaching seventh abdominal segment, broad, lacking fringe on small basal part of anterior margin, and on shorter distance of hind margin, with no double-fringed hairs. Fore femora stout, twice as long as wide, not reticulated, as long as tibiæ, with many short setæ, and two or three very long setæ near base; middle and hind femora with a very long seta near base; fore tibiæ about 3.8 times as long as wide, with a much longer seta on the distal part; tarsi large, lacking teeth; claws distinct. Body about 4.5 mm, head about 0.369 mm long, 0.268 mm wide, antenna about 0.748 mm long, pronotum about 0.254 mm long, 0.438 mm wide, pterothorax about 0.646 mm wide, first abdominal tergite about 0.231 mm wide, tube about 0.9 mm long, 0.115 mm wide at base, 0.051 mm wide at apex, fore femur about 0.277 mm long, fore tibia about 0.29 mm long.

Food plant.—Unknown.

Habitat.—Raisha.

Three specimens were taken by Dr. Y. Miwa, June 26, 1935, on a decayed tree. This species differs from all known members of the genus in the shorter tube. The most closely related form is *Leeuwenia pugnatrix* Priesner, which is easily distin-

guished from the present new species by the shape of the head and the longer tube. This species is strongly sclerotized, not becoming pale even when treated with caustic potash, but becomes clear when soaked in Schulz's mixture. The type specimens are in the collection of the Department of Agriculture, Research Institute, Formosa.

ECACANTHOTHRIPS MATSUMURAI Ishida.

Ecacanthothrips matsumurai ISHIDA, Insecta Mats., Sapporo **8** (1933) 149.

Habitat.—Taihoku.

The food habit is unknown.

ECACANTHOTHRIPS SANGUINEUS Bagnall.

Ecacanthothrips sanguineus BAGNALL, Trans. Nat. Hist. Soc. Northumberland, n. ser. **3** (1908) 535 (not available); BAGNALL, Ann. Soc. Ent. Belg. **52** (1908) 348; KARNY, Suppl. Ent. **2** (1913) 130; MOULTON, Ann. Zool. Jap. **11** (1928) 322; RAMAKRISHNA AYYAR, Mem. Dept. Agr. India, Ent. Ser. **10** (1928) 274; PRIESNER, Treubia **11** (1930) 361; ISHIDA, Insecta Mats., Sapporo **8** (1933) 148; HOOD, Stylops **4** (1935) 195.

Habitats.—Koshun, Kosen (formerly Kosempo).

The food habit is unknown.

ECACANTHOTHRIPS COXALIS Bagnall var. FORMOSENSIS var. nov.

Male.—Black; antennæ dark, with a yellowish brown tinge, third and fourth segments paler on middle area of outer side, fifth and sixth segments slightly paler on basal half; sense cones dark on third, but transparent on other segments; wings hyaline, slightly pale brownish on distal part, with a median gray line not reaching apex, which is obsolete about middle; femora black; fore tibiæ yellow, blackish along both sides, middle and hind tibiæ black, yellow on small distal part; tarsi pale yellowish, dusky on the apex; setæ dusky, but those on hind angles of abdominal segments pale yellowish; capitate setæ pale apically. Head including the frontal produced part 1.7 times as long as wide, about twice as long as prothorax, twice as long as tube, very slightly convex on cheeks, very slightly narrowed near base, broadest across about middle of cheeks; cheeks over twice as long as eyes, without warts, but with three stout pointed setæ which are shorter anteriorly and about 0.014 to 0.023 mm long; frontal produced part indented at apex; lateral postocular setæ stout capitate, approximately on cheeks, a little longer than setæ on the cheeks, not reaching eyes, about 0.032 mm long; mesal postocular setæ very long, stiff, eminently capitate, di-

rected anterolaterally, reaching beyond a line drawn across middle of eyes, laterad of eyes, slightly longer than eyes, as far apart from eyes as from cheeks, about 0.115 mm long. Eyes not protruding. Antennæ about 1.8 times as long as head; first segment wider than long; second longer than first, constricted basally; third much narrowed on basal part, asymmetrical, more rounded on outer side, striate on basal third, with fourteen sense cones in a single ring on distal part, and some long curved bristles; fourth striate on basal half, with four sense cones; fifth very slightly striate on basal part, slightly constricted on distal part, with two sense cones; sixth similar to, but smaller than, fifth, not striate; seventh with a sense cone; eighth pointed apically, with a very long apical seta; bristles on third and fourth stouter than those on other segments; lengths (and widths) of segments about as follows: III, 0.115 mm (0.06 mm; 0.016 mm at basal part); IV, 0.115 (0.051; 0.018 at base); V, 0.115 (0.037); VI, 0.083 (0.028); VII, 0.065 (0.023); VIII, 0.046 (0.014). Pronotum much wider than long, narrowed anteriorly on anterior half, somewhat constricted behind middle, with a median black line not reaching margins; anterior angular setæ stout, capitate, 0.058 mm long; lateral postangular setæ similar to, but slightly longer than, anterior ones, 0.065 mm long; mesal postangular setæ much longer; midlateral setæ much shorter than anterior angular ones. Fore coxæ scarcely protruding beyond pterothorax, with two very stout pointed setæ equal in length, and a much shorter similar one, longer ones shorter than angular setæ on pronotum, about 0.037 to 0.04 mm long. Pterothorax a little wider than long, on anterior part nearly as wide as posterior margin of prothorax including coxæ, a little narrowed posteriorly. Abdomen broadest at base; first tergite triangular, as long as wide, rounded at corners; postangular bristles of abdominal segments stiff, capitate, as long as, or shorter than, segments, but those on ninth segment as long as tube, bristles on seventh segment about 0.129 mm long; tube stout, tapering, not swollen, twice as long as wide at base, base twice as wide as apex; apical long setæ longer than tube. Wings narrow. Fore femora stout, about twice as long as wide, broadly rounded on lateral side, with a long fine seta on basal part, and a distinct tooth at about middle and also at end; teeth pointed, longer than wide, distal one conical, expanded towards base, slightly shorter, but more sharply pointed than basal one; middle femora thrice as long as wide, with two long, stout, cap-

itate setæ on anterior margin, which are about 0.037 to 0.042 mm long; hind femora about four times as long as wide, with three long, stout, capitate setæ and a few shorter pointed ones in a row on anterior margin; these capitate setæ slightly curved; fore tibiæ shorter than femora, 4.5 times as long as wide, with a very small rounded tubercle on basal part and one or two similar ones on distal part, which are wider than long, one or two very short indistinct teeth also discernible on middle part and a long fine seta on distal part; fore tarsi with an eminent tooth, which is pointed, distinctly longer than wide, slightly indented on mesal side, expanded basally, very slightly rounded on lateral side, and slightly shorter than width of tarsi. Body about 2.15 mm, antenna about 0.65 mm, sense cone on third antennal segment about 0.037 mm long, head including frontal produced part about 0.369 mm long, 0.203 mm wide across eyes, 0.102 mm wide in front of eyes, 0.217 mm wide across cheeks, eyes 0.102 mm long, pronotum 0.346 mm wide at hind end, mesothorax about 0.425 mm wide, tube 0.185 mm long, 0.092 mm wide at the base, longer apical setæ 0.22 mm long, hind wing 0.046 mm wide, fore femur 0.323 mm long, basal tubercle 0.03 mm long, tarsal tooth 0.032 mm long.

Habitat.—Heito.

A single specimen was taken on a decayed branch of *Artocarpus*, March, 1935, by Mr. R. Yamaho. The food habit is not known. Differs from the typical form of *Ecacanthothrips coxalis* Bagnall in the following characters: The third and fourth antennal segments paler on the middle of the lateral part, the fourth and fifth not distinctly paler at the base. Fore femora narrower, twice as long as wide. Setæ on the pronotum longer. Tooth on the fore tarsi very slightly indented on the mesal margin, expanded basally. Middle and hind femora with eminent capitate setæ. The type specimen is in the collection of the Department of Agriculture Research Institute, Formosa.

GIGANTOTHRIPS CRAWFORDI Hood.

Gigantothrips crawfordi HOOD, Insec. Inscit. Menst. 7 (1919) 71.
Gigantothrips elegans TAKAHASHI (nec Zimmerman), Bot. & Zool. Tokyo 2 (1934) 1829.

Food plants.—*Ficus nervosa, F. wightiana, F.* sp.

Habitats.—Taihoku, Shinten, Hakumo near Tosei, Hori, Shirin near Taihoku.

Sometimes occurs in large numbers on the lower sides of the leaves. Does not form galls. Previously known from the Philippines.

GIGANTOTHRIPS VENAPENNIS Moulton.

Gigantothrips venapennis MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 321.

Food plant.—Unknown.
Habitat.—Kagi.

MEGATHRIPINÆ

ELAPHROTHRIPS FALCATUS Karny.

Elaphrothrips falcatus KARNY, Ent. Runds. 29 (1912) 150; MOULTON, Ann. Zool. Jap. 11 (1928) 322; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1888; PRIESNER, Rev. Zool. Bot. Africa. 22 (1932) 330.
Dicaiothrips falcatus PRIESNER, Boll. Lab. Zool. Portici 21 (1927) 80.

Habitats.—Kagi, Shinten.

Found on the stems and branches of *Artocarpus integrifolia, Sterculia nobilis,* and *Psidium guajava.*

ELAPHROTHRIPS FORMOSANUS (Karny).

Idolothrips formosanus KARNY, Suppl. Ent. 2 (1913) 130; MOULTON, Ann. Zool. Jap. 11 (1928) 336.
Elaphrothrips formosanus PRIESNER, Konowia 13 (1934) 193; 14 (1935) 64.

Food plant.—Unknown.
Habitat.—Takao.

MACHATOTHRIPS ARTOCARPI Moulton.

Machatothrips artocarpi MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 322; TAKAHASHI, Iconogr. Insect. Japon. (1932) 1889; PRIESNER, Rev. Zool. Bot. Africa 22 (1932) 344.

Habitats.—Kagi, Heito, Kuraru.

Found on the stem of *Artocarpus integrifolia* and under the bark of decayed trees.

MACHATOTHRIPS CELOSIÆ Moulton.

Machatothrips celosiæ MOULTON, Trans. Nat. Hist. Soc. Formosa 18 (1928) 325; PRIESNER, Rev. Zool. Bot. Africa 22 (1932) 344.

Food plant.—*Celosia argentea.*
Habitat.—Kagi.

PHOXOTHRIPS PUGITOR Karny.

Phoxothrips pugitor KARNY, Suppl. Ent. 2 (1913) 132; MOULTON, Ann. Zool. Jap. 11 (1928) 337.

Food plant.—Unknown.
Habitat.—Koshun.

RHÆBOTHRIPS LATIVENTRIS Karny.

Rhæbothrips lativentris KARNY, Suppl. Ent. 2 (1913) 129; Acta Soc. Ent. Czech. 17 (1920) 42; Archiv f. Zool. 17 (1924) 12; MOULTON, Ann. Zool. Jap. 11 (1928) 337; PRIESNER, Philip. Journn. Sci. 57 (1935) 370.

Food plant.—*Gossypium indicum.*

Habitats.—Taihoku, Kagi, Anpin.

Found in the cotton bolls in Formosa, though taken on *Cassia occidentalis* at Koronya, Ponape Island (Japanese South Sea Islands).

Machatothrips ipomoeæ Ishida[4] may be identical with this species.

[4] Insecta Mats. 7 (1932) 12.

ILLUSTRATIONS

TEXT FIGURES

THE NASUTE TERMITES OF THE PHILIPPINES

By S. F. LIGHT and F. J. WILSON

Of the University of California, Berkeley

TWENTY-SIX TEXT FIGURES

PHILIPPINE NASUTE TERMITES

Genus *Lacessititermes* Holmgren.
1. *Lacessititermes palawanensis* Light.
2. *Lacessititermes holmgreni* sp. nov.

Genus *Hospitalitermes* Holmgren.
3. *Hospitalitermes luzonensis* (Oshima).

Genus *Grallatotermes* Holmgren.
4. *Grallatotermes admirabilus* Light.
5. *Grallatotermes splendidus* sp. nov.

Genus *Nasutitermes* Banks.

Subgenus *Havilanditermes* Light.
6. *Nasutitermes atripennis* (Haviland).

Subgenus *Nasutitermes* sen. str.
7. *Nasutitermes gracilis* (Oshima).
8. *Nasutitermes mollis* sp. nov.
9. *Nasutitermes luzonicus* (Oshima).
10. *Nasutitermes simulans* sp. nov.
11. *Nasutitermes latus* sp. nov.
12. *Nasutitermes panayensis* (Oshima).
13. *Nasutitermes meridianus* sp. nov.
14. *Nasutitermes oshimai* sp. nov.
15. *Nasutitermes chapmani* sp. nov.
16. *Nasutitermes parvus* sp. nov.
17. *Nasutitermes rotundus* sp. nov.
18. *Nasutitermes balintauacensis* (Oshima).
19. *Nasutitermes taylori* sp. nov.
20. *Nasutitermes castaneus* (Oshima).
21. *Nasutitermes mcgregori* (Oshima).
22. *Nasutitermes constricticeps* sp. nov.
23. *Nasutitermes busuangæ* sp. nov.
24. *Nasutitermes brevicornis* sp. nov.

Genus *Subulitermes* Holmgren.
25. *Subulitermes mariveles* sp. nov.
26. *Subulitermes mindanensis* sp. nov.

INTRODUCTION

Forty-eight species of termites have been reported from the Philippines, two by Hagen (1858), one by Haviland (1898),

thirty by Oshima (1914, 1916, 1917, 1920), and fifteen by Light (1921, 1929, 1930). Previous reductions to synonymy (Light, 1930) decreased that total to thirty-nine (Light, 1930, with the addition of *Neotermes grandis* Light, which was omitted from the list). Of these thirty-nine species sixteen are nasute, thirteen of them recorded by Oshima (1914, 1916, 1917, 1920) and three by Light (1930). Oshima's *Eutermes minutus* (1917) was reduced by Light (1930) on the basis of Oshima's statement that this was a manuscript name replaced by *N. gracilis,* which appeared by mistake.

Of these thirteen nasute species of Oshima six are reduced to synonymy in this paper, as follows:

Eutermes (*Hospitalitermes*) *hospitalis* (Haviland) Oshima, 1920, to *Hospitalitermes luzonensis* (Oshima).
Eutermes (*Hospitalitermes*) *saraiensis* Oshima, 1916, to *Hospitalitermes luzonensis* (Oshima).
Eutermes (*Eutermes*) *las-piñasensis* Oshima, 1920, to *Nasutitermes* (*Nasutitermes*) *luzonicus* (Oshima).
Eutermes (*Eutermes*) *manilensis* Oshima, 1916, to *Nasutitermes* (*Nasutitermes*) *luzonicus* (Oshima).
Eutermes (*Trinervitermes*) *menadoensis* Oshima, 1920, to *Nasutitermes* (*Nasutitermes*) *luzonicus* (Oshima).
Eutermes (*Rotunditermes*) *culasiensis* Oshima, 1920, to *Nasutitermes* (*Nasutitermes*) *gracilis* (Oshima).

Sixteen new species are described, however, which makes a total of forty-nine species of termites known to occur in the Philippine Archipelago to date, of which twenty-six are nasutes, as listed at the head of this paper.

The material studied by Oshima included a small collection from Dr. C. F. Baker made in the vicinity of the College of Agriculture at Los Baños, Laguna Province, Luzon, and several collections made by R. C. McGregor in various parts of the Archipelago. The named collections of Doctor Oshima, formerly in the Government Institute of Science, Taihoku, Formosa, were briefly studied there by the senior author in 1922. They were removed when Doctor Oshima returned to Japan (fide T. Shiraki). It is extremely unfortunate that Oshima's types were not available for study at this time, since, judging from conditions of preservation in 1922, they are destined to rapid deterioration. Furthermore, Oshima designated neither a holotype nor a type collection, and our observations indicated that the various collections labeled as belonging to a single species often actually represented two or more species. Autotype specimens of a few

species have been available during this investigation. These were kindly sent by Doctor Oshima at Mr. McGregor's request when the senior author first began the study of Philippine termites. Many of Oshima's nasute species were not represented in this material nor is the exact type status of this material known in all cases. Incomplete as it is, it has nevertheless been of the greatest value in settling certain difficult questions.

In spite of this paucity of authentic comparative material, all but one of Oshima's thirteen species of nasutes have been accounted for. Six have been found to be synonymous with other species described by Oshima and present in our collections. The remaining six occur in our collections and have been identified and redescribed. The single species yet to be redescribed is *Nasutitermes mcgregori* Oshima. Oshima's descriptions in general are not sufficiently definite or complete as regards diagnostic specific characters to allow for ready identification of his species, but this one unrevised species seems more than usually definite and has been incorporated on the basis of characters given in Oshima's descriptions and figures.

MATERIAL STUDIED

Extensive collections representing approximately 370 colonies were used in this study. Numerous persons have contributed to these collections, among whom must be mentioned Mr. R. C. McGregor, of the Philippine Bureau of Science, and Dr. E. H. Taylor, formerly of the Bureau of Science, now in the University of Kansas.

Numerous species are represented in the collection by but one or two colonies, a condition which indicates the necessity for careful collecting in the less-frequented regions. Such collecting may be expected to yield unknown species and to increase the known range of those here reported. These new species are to be expected chiefly in the mountainous areas, particularly in the southern islands of the Philippines. The species characteristic of the lowland faunas in various parts of the Islands are undoubtedly reported here. The two dominant species, as will be seen by referring to the lists of collections, are *Nasutitermes luzonicus* (Oshima) and *N. panayensis* (Oshima). *Nasutitermes luzonicus*, the common black-headed Philippine nasute, while occurring throughout the Archipelago, is common only in the northern portion of its range, especially in Luzon, where it is the common nasute and one of the commonest termites. *Nasutiter-*

mes panayensis, the common brown-headed Philippine nasute, is the dominant nasute species throughout the Visayas and one of the commonest elements of the termite fauna there.

METHODS

Descriptions have been restricted to brief diagnoses involving characters expected to be of value in specific differentiation. No attempt has been made to describe workers, since these are not satisfactory for specific differentiation in the present state of our knowledge. Illustrations have been confined to line drawings, chiefly of the head, which bring out such diagnostic characters as dorsal profile, shape, length, and position of the rostrum in the case of the soldiers; and size of eyes and ocelli and the distances separating them in the alates. In addition the left mandible of the soldiers is illustrated for the species of *Nasutitermes* sen. str. as adding useful characters to the relatively meager set available for differentiating species in this difficult group.

TYPES

It is the practice among systematic students of the termites to choose a type colony, one individual of which is separated as the holotype, other members of which are known as paratypes, as are the members of other colonies of the same species investigated. We have followed this procedure, designating the type colony by its number in the collection of the senior author. Holotypes have been deposited in the United States National Museum save in the case of monotypic species, the types of which are retained in the collection of the senior author. Paratypes are retained in the senior author's collection; and, where available, paratypes have been deposited in the collection of Prof. A. E. Emerson, of the University of Chicago. Type collections, as complete as possible, are also to be deposited in the Philippine Bureau of Science, Manila, and in the museum of the California Academy of Sciences, in San Francisco.

TERMS AND MEASUREMENTS

The measurements and indices used in this paper are in general the same as those used in other papers of the senior author. Some, however, are new, devised to facilitate description of the characters of the nasute soldier. The dimensions and indices used are defined in the succeeding paragraphs.

Head measurements for the alate are all made with the head flat and with the dorsal side up. "Length of head of alate" (fig. 1, *on*) is measured from tip of labrum to posterior margin

of head. "Length of head capsule of alate" (fig. 1, *mn*) is here measured from the middle of the anterior end of the capsule to the center of the posterior margin of the head. "Width of head capsule of alate" (fig. 1, *rs*) is measured just behind the eyes. "Width of head with eyes" (fig. 1, *pq*) is width through centers of eyes. "Length of pronotum" is measured at the middle (from notch to notch if present) and "width of pronotum" is maximum width. Eye and ocellus measurements are made with the head turned so as to avoid foreshortening.

All measurements for the head of the nasute, except head width, are measured with the head in side view, and with the sagittal plane horizontal. "Length of head with rostrum" (fig. 1, *bc*) is measured in side view with the ventral surface of the head parallel to the scale. "Length of rostrum" (fig. 1, *de*) is measured parallel to the base line with the head, in the same position as for length of head with rostrum, from the innermost point of the front of the head below the base of the rostrum to a line from the tip of the rostrum perpendicular to the base line. This value is less than the actual length of the rostrum, therefore, when the rostrum is either elevated or depressed (fig. 1, *jt*). "Head length without rostrum" is, of course, the difference between the last two measurements. "Head production" is the horizontal extension (fig. 1, *ac*) of the head behind the posterior articulation of neck with head (fig. 1, *a*). "Head width" is measured at the widest point across the dorsal surface. "Head index" is obtained by dividing head width by head length

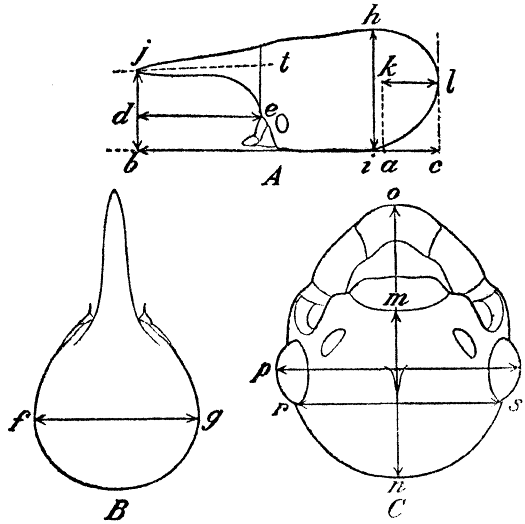


FIG. 1. *Nasutitermes taylori* sp. nov., outline drawings of head of alate and of soldier, to illustrate the dimensions used; *A*, head of soldier in lateral view; *B*, head of soldier in dorsal view; *C*, head of alate in dorsal view; *a*, junction of head and neck; *bc*, length of heal with rostrum; *de*, length of rostrum; *fg*, width of head; *hi*, height of head; *kl*, head production; *mn*, length of head capsule of alate; *on*, length of head over all; *pq*, width of head of alate through the eyes; *rs*, width of head of alate behind the eyes.

without rostrum; "head-rostrum index," by dividing rostrum length by head length without rostrum; "head production index," by dividing head production by head length; and "leg elongation index," by dividing length of fore tibia by length of head without rostrum.

All extensively used indices have been arrived at, it will be seen, by dividing the particular dimension by head length without rostrum. Others are defined where first used.

The subgroups of nasute termites of the genus *Eutermes* Hagen (now *Nasutitermes* Banks) defined by Holmgren (1911, 1913) as subgenera are variously used by different authors, as subgenera and genera. Awaiting a much-needed revision to determine their proper status, it seems wise to follow the custom. Thus, we have here used them as genera in this paper following the lead set in the earlier papers of the senior author on Philippine termites (1930) and that of Kemner (1934), although in the senior author's studies of American termites he has followed the lead of Emerson and Snyder and considered them as subgenera (1930).

Soldiers of the smaller species show certain characters that suggest the possibility that they may belong to one or the other of the subgenera briefly differentiated by Holmgren (1911). The fact that the postclypeus is short in the workers of all save *N. mindanensis* sp. nov. and *N. mariveles* sp. nov. and in the alates where present makes it impossible to place these save in *Nasutitermes* sen. str. This holds for the species variously placed by Oshima in *Grallatotermes, Rotunditermes, Ceylonitermes,* and *Trinervitermes.*

Nasutitermes mindanensis, certainly, and *N. mariveles,* somewhat doubtfully, belong to *Subulitermes,* as indicated by the longer swollen postclypeus of the worker and the lack (*S. mindanensis*) or vestigial nature (*S. mariveles*) of the free apical portion of the soldier mandible. We have followed Kemner in considering *Subulitermes* a separate genus, although the differences seem more nearly of subgeneric value.

Key to the genera of nasute termites found in the Philippine Islands.

ALATES

1. Smaller, head with eyes less than 1.60 mm wide; pronotum light save in smaller species.
   Subulitermes Holmgren; *Nasutitermes,* subgenus *Nasutitermes* s. s.
   Larger, head with eyes more than 1.70 mm wide; pronotum dark........ 2.
2. Antennal segment III slightly, if at all, longer than II........ 3.
   Antennal segment III markedly longer than II........ 4.

3. Wings yellow-brown; eyes very large and prominent; pronotum with central notch in posterior margin................ *Grallatotermes* Holmgren.
   Wings black-brown; eyes medium in size; pronotum without notch in posterior margin........ *Nasutitermes*, subgenus *Havilanditermes* Light.
4. Antennal segment III twice as long as II; wing membrane unpigmented. *Hospitalitermes* Holmgren.
   Antennal segment III about one and one-half times as long as II; wing membrane pigmented, brown .... *Lacessititermes* Holmgren.

SOLDIERS

1. Head greatly produced behind and greatly depressed, dorsal profile strongly concave (figs. 2, *c;* 4, *c;* 6, *b*).. 4.
   Head not usually greatly produced, never strongly depressed (fig. 8, *e*); when produced, head narrow and constricted (fig. 22, *a*)..................... 2.
2. Antennæ short, median segment less than twice as long as broad, or when antennæ are long, head constricted (fig. 22, *a*)............................. 3.
   Antennæ elongated, head not constricted (figs. 7, *a*). *Nasutitermes*, subgenus *Havilanditermes* Light.
3. Free apical portion of mandible lacking or vestigial; postclypeus of worker swollen, about half as long as wide. *Subulitermes* Holmgren.
   Free apical portion of mandible well developed; postclypeus of worker not especially swollen, less than half as long as wide. *Nasutitermes*, subgenus *Nasutitermes* sen. str.
4. Rostrum short and thick; legs only moderately elongated, hind femora considerably short of end of abdomen........ *Grallatotermes* Holmgren.
   Rostrum long or shorter and very slender; legs greatly elongated, hind femora longer than abdomen... 5.
5. Rostrum long, relatively thick at base; antennal segment III shorter than IV .... *Lacessititermes* Holmgren.
   Rostrum short and slender; antennal segment III longer than IV. *Hospitalitermes* Holmgren.

Genus LACESSITITERMES Holmgren

Key to the two Philippine species of Lacessititermes.

ALATES

1. Pronotum with deeply notched posterior margin; fontanel more than half as wide as ocellus.. *L. holmgreni* sp. nov.
   Posterior margin of pronotum entire; fontanel very narrow, slitlike. *L. palawanensis* Light.

SOLDIERS

1. Head short, head-rostrum index about 0.70; apical fourth of rostrum red or yellowish... *L. holmgreni* sp. nov.
   Head long, head-rostrum index about 0.50; rostrum without well-marked apical area.. *L. palawanensis* Light.

1. LACESSITITERMES PALAWANENSIS Light. Text fig. 2.

Lacessititermes palawanensis LIGHT, 1930.

Dealate (young queen).—Generally dark brown; head black-brown, postclypeus light brown, antennæ yellow, pronotum rusty

yellow-brown. Ocelli (fig. 2, *a*) separated from eyes by more than their long diameter but less than twice their short diameter; width between eyes 1.22 mm; head width through eyes 1.80 mm. Fontanel (fig. 2, *a*) narrow, slitlike; region about fontanel only slightly sunken. Posterior margin of pronotum entire (fig. 2, *a*); mesonotum and metanotum roundly excavated, corners rounded.

Soldier (*fig. 2, b and c*).—Head black-brown; nota, tergites, and first segment of antennæ dark smoky brown; coxæ, femora, and region of head about antennæ rusty brown; tibiæ, tarsi, and distal halves of antennæ very light yellow-brown; rostrum of same color as head or with an indistinct paler apical region; rostrum relatively slender. Segment II of antennæ distinctly shorter than III (fig. 2, *b*); head without hairs or with one or two hairs near posterior; head length 1.75 to 1.85 mm, head width about 1 mm; head relatively short; head-rostrum index about 0.70. All abdominal tergites with a posterior row of stiff hairs.

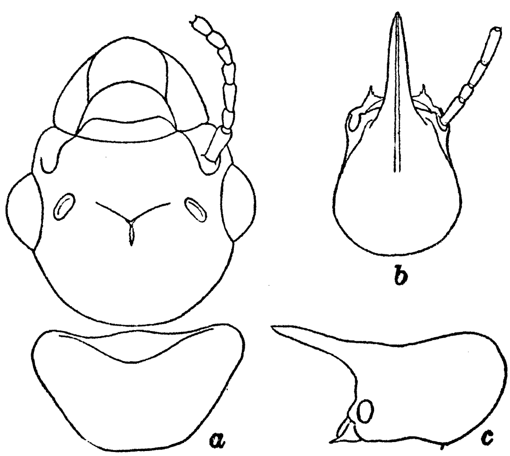


FIG. 2. *Lacessititermes palawanensis* Light; *a*, head and pronotum of alate in dorsal view; *b* and *c*, head of soldier in dorsal and lateral views, respectively.

Measurements in millimeters of a queen of Lacessititermes palawanensis Light.

Length of head	2.16
Length of head capsule	1.50
Width of head through eyes	1.83
Long diameter of ocellus	0.20
Length of fontanel	0.11
Diameter of eye	0.45
Distance between inner margins of eyes	1.43
Length of antennal segment I	0.24
Length of antennal segment II	0.15
Length of antennal segment III	0.22
Length of pronotum	0.81
Width of pronotum	0.50

Measurements in millimeters of a soldier of Lacessititermes palawanensis Light.

Length of head	1.62
Length of rostrum	0.57
Width of head	1.02
Width of pronotum	0.58
Length of pronotum	0.26
Length of hind tibia	2.15
Head-rostrum index	0.50

Biology and distribution.—The single colony was taken in 1923 by Dr. E. H. Taylor on Thumb Peak near Iwahig, Palawan. He reported the species as occurring to an elevation of above 4,500 feet and building small, very light, paper nests in small shrubs or rattan. He also reports that there were no covered runways above or below the nest, which would mean that the species is a forager, as its long legs and dark color would indicate.

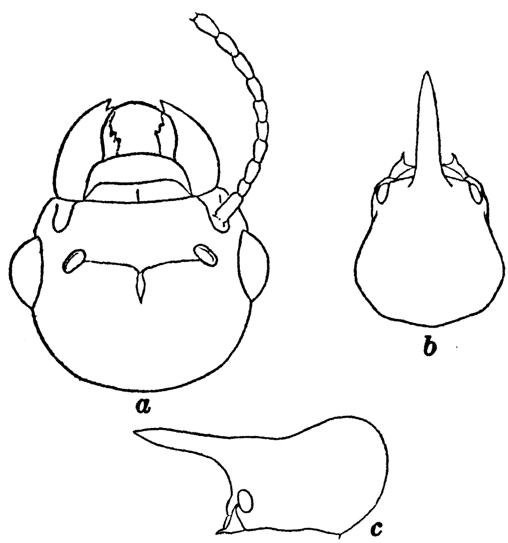


FIG. 3. *Lacessititermes holmgreni* sp. nov.; *a*, head of alate in dorsal view; *b* and *c*, head of soldier in dorsal and lateral views, respectively.

2. **LACESSITITERMES HOLMGRENI sp. nov. Text fig. 3.**

Alate (fig. 3, a).—Generally dark brown; head black-brown; postclypeus yellow-brown; antennæ light yellow-brown; pronotum dark brown, lighter behind. Ocelli separated from eyes by about their long diameter; width between the eyes 1.50 mm, width of head through the eyes 2.08 mm. Fontanel large, lancet-shaped, in a strongly sunken area. Posterior margin of pronotum deeply notched; mesonotum and metanotum roundly excavated, the corners angular.

Soldier (fig. 3, b and c).—Head black; nota and tergites dark brown; antennæ, lateral thoracic segments, and coxæ brown; femora yellow-brown; tibiæ and tarsi lighter; rostrum relatively short, with apical reddish area. Segments II and III of antennæ subequal. Head without hairs or with one or two posterior

hairs; head length about 1.80 mm, head width about 1 mm. All abdominal tergites with a single posterior row of stiff hairs.

DESCRIPTIONS

Alate.—Head dark mahogany brown; postclypeus, antennæ, and legs yellow-brown; labrum very light yellow-brown; pronotum brown, lighter posteriorly; mesonotum and metanotum anteriorly ivory brown, darker posteriorly; tergites dark brown; sternites brown, centrally slightly paler; wing membrane light brown, radius sector deep brown, costal margin brown, subcostal stripe nearly as wide as radius sector, brown with yellow cast.

Head shaped as in fig. 3, *a;* central region of head about fontanel markedly sunken.

Fontanel (fig. 3, *a*) lancet-shaped, more than half as wide as ocellus and slightly longer, flaring anteriorly to form lateral points, which continue to the ocelli as faint lines.

Ocellus (fig. 3, *a*) elliptical, long diameter about one-third that of eye; separated from eye by the long diameter of ocellus.

Eye projecting, large, separated from lower margin of head by about one-fifth its own diameter, from upper margin of head by about one-half its own diameter, and from posterior margin by somewhat more than its own diameter; width of head between eyes 1.35 mm.

Antennæ of about the same color throughout, segment II much shorter than III.

Measurements in millimeters of a typical alate of Lacessititermes holmgreni sp. nov., from the type collection, No. 1712.

Length over all	16.01
Length of forewing	14.17
Width of forewing	3.86
Length of head	2.16
Length of head capsule	1.50
Width of head capsule	1.57
Width of head with eyes	1.87
Length of pronotum	0.844
Width of pronotum	1.54
Diameter of eye	0.55
Long diameter of ocellus	0.20
Short diameter of ocellus	0.16

Soldier.—Head and rostrum deep black-brown shading into mahogany brown at base; distal one-fourth to one-fifth of ros-

trum reddish; nota and tergites dark brown; antennæ, lateral thoracic sclerites, and coxæ brown; tibiæ and tarsi somewhat lighter.

Head and rostrum shaped as in fig. 3, *b* and *c;* rostrum elevated, with a slight hump near its base; rostrum basally thick, tapering throughout, about 0.2 mm thick at middle.

Antennæ twice as long as head with rostrum, same color throughout; segments VII and VIII longest, distal segments decreasing in length; segment III shorter than or nearly as long as IV.

Measurements in millimeters, and indices, of a typical soldier of Lacessititermes holmgreni sp. nov., from the type collection, No. 1712.

Length of head and rostrum	1.80
Length of head without rostrum	1.06
Length of rostrum	0.72
Head production	0.27
Height of head	0.96
Width of head	1.14
Length of fore tibia	1.32
Head index	0.90
Head-rostrum index	0.68
Head production index	0.23
Leg elongation index	1.15

Biology and distribution.—Three collections were made by A. C. Duyag, in May and June, 1934, all from Dinagat, Dinagat Island, Surigao Province, just north of the northernmost point of Mindanao. All contained queens and one contained alates. Nothing is known of their biology, but they are almost certainly carton-nest builders.

Systematic position.—The alate of this species differs from all save that of *L. palawanensis* in the combination of large head size with ocelli removed from the eyes by about their long diameter. The first form reproductive differs from that of *L. palawanensis,* which otherwise it resembles very closely, in the larger fontanel and the notched posterior margin of the pronotum.

The soldier keys out to *L. ransoneti* Holmgren in Holmgren's key (1913). From this species it differs, however, in being larger with much thicker and somewhat longer rostrum. From *L. palawanensis* Light the nasute differs markedly in its much longer, thicker rostrum with a red tip.

Genus HOSPITALITERMES Holmgren

3. HOSPITALITERMES LUZONENSIS Oshima. Text fig. 4.

? *Eutermes* (*Hospitalitermes*) *saraiensis* OSHIMA, 1916.
Eutermes (*Hospitalitermes*) *luzonensis* OSHIMA, 1917.
? *Eutermes* (*Hospitalitermes*) *hospitalis* OSHIMA, 1916, 1920.

Alate.—Head posteriorly brownish black, anteriorly brown; postclypeus same color as head; labrum light brown; antennæ light brownish yellow; pronotum dark brown, bordered laterally with very light yellowish brown; mesonotum and metanotum light brown; tergites dark brown; sternites brown, centrally pale; wing membrane pale whitish with faint yellowish tinge, almost unpigmented save for dark brown radius sector and light brown costal margin.

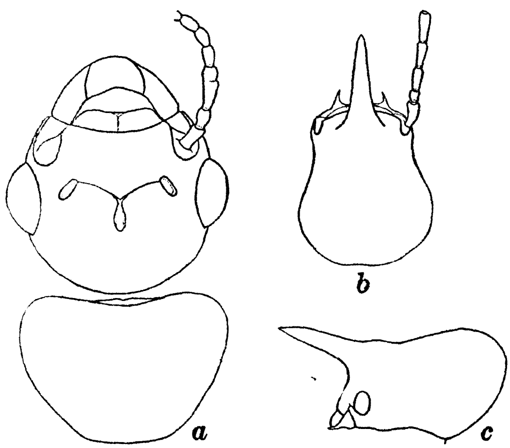


FIG. 4. *Hospitalitermes luzonensis* Oshima; *a*, head and pronotum of alate in dorsal view; *b* and *c*, head of soldier in dorsal and lateral views, respectively.

Head shaped as in fig. 4, *a;* broad behind, frontal region constricted; eyes wide apart, protruding.

Fontanel (fig. 4, *a*) smoothly elliptical, about equal to ocellus in length but narrower than ocellus, located just posterior to a line joining posterior margins of ocelli, in a ridge which separates two lateral sunken areas; frons sunken, especially so immediately in front of fontanel.

Ocelli elliptical, more than one-half as wide as long, nearly vertical in position; separated from eye by at least short diameter of ocellus.

Eye separated from lower margin of head by about one-fifth, from upper margin of head by nearly one-half, and from posterior margin by slightly more than, its own diameter.

Antennæ somewhat elongated, decreasing in width distally, of fifteen or sixteen segments; where fifteen, III much the longest, at least twice as long as II; where sixteen, II and IV subequal, III larger.

Pronotum (fig. 4, *a*) long, considerably longer than one-half its width, broadest near anterior end; anterior margin somewhat uplifted at center, nearly straight but with median emargination; anterolateral corners rounded; sides nearly straight, strongly receding, rounding very broadly into narrow, slightly convex, posterior margin; posterior region of pronotum depressed. Mesonotum and metanotum angularly excavate behind, metanotum deeply so.

Wings heavily haired but without other ornamentation; hairs evenly distributed on membrane; median and cubitus and its branches marked by close-set lines of hairs set off by clear zones on either side; median near cubitus; cubitus with six unbranched basal branches, the first five relatively heavily pigmented, the sixth with some pigment distally; distal branches of cubitus from three to six, unpigmented, one or more branched. No costal stripe, usual dark zone behind radius sector narrower than vein.

Measurements in millimeters of an alate of **Hospitalitermes luzonensis** *Oshima, from collection 323, from Basilan Island.*

Length over all	14.35
Length of forewing	12.70
Width of forewing	3.50
Length of head	1.74
Length of head capsule	1.25
Width of head capsule	1.31
Width of head with eyes	1.68
Length of pronotum	0.90
Width of pronotum	1.45
Diameter of eye	0.45
Long diameter of ocellus	0.19
Short diameter of ocellus	0.12

Soldier (*fig. 4, b and c*).—Head black to dark mahogany brown behind, lighter anteriorly, distal half of rostrum lighter when head is darkly pigmented. Antennæ, nota, tergites, coxæ, and femora dark brown, heavily pigmented, nota darkest; sternites, tibiæ, and tarsi pale.

Head and rostrum shaped as in fig. 4, *b* and *c*. Head enormously produced and remarkably elevated behind; rostrum short, slender, somewhat uplifted; dorsal profile deeply concave.

Antennæ of fourteen segments, greatly elongate, nearly as long as body. Forelegs about as long as antennæ, other legs much longer.

Measurements in millimeters, and indices, of a soldier of Hospitalitermes luzonensis Oshima, from collection S23, from Basilan Island.

Length of head and rostrum	1.74
Length of head without rostrum	1.20
Length of rostrum	0.54
Head production	0.54
Height of head	0.87
Width of head	1.11
Length of hind tibia	2.10
Head index	0.93
Head-rostrum index	0.45
Head production index	0.45
Leg elongation index	1.60

Systematic position.—Examination of a long series from various parts of the Archipelago indicates the presence of a single, widespread, highly variable species of this genus.

This species agrees with the paratypes of *H. luzonensis* (Oshima), which were available for comparison. No satisfactory differences between this species and *H. saraiensis* and *H. hospitalis* are to be derived from the descriptions. The inference is that there is but the single species of the genus in the Philippines, but until type material of Oshima's *H. saraiensis* is available it seems best to retain the more recent name.

Oshima correctly considered the common Philippine species, his *H. luzonensis,* to be distinct. As brought out in part by the table below it is nearest to *H. hospitalis* (Haviland), but differs from it in that the soldier has paler antennæ, in that the antennæ of *H. luzonensis* are considerably less elongated than those of *H. hospitalis,* and in that the legs are considerably shorter actually and in proportion to the head length than in *H. hospitalis.*

These differences in the soldiers are brought out in the table below, which presents certain characters of the common Malayan and Indian species. The indices recorded were obtained as follows: "Head-rostrum index" by dividing head length by rostrum length (p. 465), "III-index" by dividing the length of antennal segment III by the length of head with rostrum, and "tibial index" by dividing the length of the head with rostrum by the length of hind tibia.

The close agreement in length of head with rostrum in this group of five species is notable as is the great variation in rostrum length within *H. luzonensis* as brought out by a range

in head-rostrum index of from 0.36 to 0.50 in the five specimens whose measurements are presented. This probably represents the extremes, however, for the range in another group of nineteen was only from 0.40 to 0.47. Evidently, however, this index will only be available when range and average are known. III-index seems more diagnostic, since although here there is a range from 0.12 to 0.16 in *H. luzonensis,* indicating considerable variation in length of segment III (as also, of course, in the head length), yet this figure is always less than that found for the single individual of *H. hospitalis* available. The tibial index also presents possibilities for diagnostic purposes.

Comparison of Oriental species of Hospitalitermes Holmgren.

Species.	Source.	Length of head without rostrum.	Length of head.	Length of rostrum.	Head-rostrum index.	Length of antennal segment III.
		mm.	*mm.*	*mm.*		*mm.*
Hospitalitermes hospitalis	Borneo	1.77	1.26	0.51	0.40	0.333
Hospitalitermes luzonensis	Laguna (cotypes)	1.80	1.32	0.48	0.36	0.290
Do.	do.	1.74	1.23	0.51	0.41	0.261
Do.	Ilocos Norte	1.81	1.22	0.59	0.47	0.29
Do.	Mindoro	1.80	1.20	0.60	0.50	0.2175
Do.	do.	1.71	1.19	0.52	0.45	0.232
Hospitalitermes umbrinus	Borneo	1.72	1.195	0.62	0.53	0.366
Hospitalitermes monoceros	Ceylon	1.68	1.22	0.46	0.38	0.244
Do.	do.	1.76	1.32	0.44	0.33	0.026
Hospitalitermes flaviventris	Malacca	1.76	1.13	0.63	0.55	0.025

Species.	Source.	Length of antennal segment IV.	III-index.	Length of tibia.	Tibial index.	Color.
		mm.		*mm.*		
Hospitalitermes hospitalis	Borneo	0.290	0.19	2.64	0.67	Very dark.
Hospitalitermes luzonensis	Laguna (cotypes)	0.2175	0.16	2.46	0.73	Dark.
Do.	do.	0.246	0.15	2.28	0.76	Do.
Do.	Ilocos Norte	0.23	0.16	2.46	0.73	Do.
Do.	Mindoro	0.232	0.12	2.34	0.77	Do.
Do.	do.	0.232	0.136	2.32	0.76	Do.
Hospitalitermes umbrinus	Borneo	0.319	0.20	2.90	0.62	Lighter.
Hospitalitermes monoceros	Ceylon	0.235	0.145	2.52	0.66	Medium.
Do.	do.	0.25	0.15	2.56	0.69	Do.
Hospitalitermes flaviventris	Malacca	0.25	0.14	2.48	0.71	Light.

Distribution.—This species is widespread throughout the Archipelago. The collections in hand range from the northern

end of Luzon to Palawan and the southern end of Mindanao. In Luzon the following provinces are represented: Ilocos Norte, Cagayan, Pangasinan, Pampanga, Bataan, Rizal, Laguna, Cavite, and Tayabas (including Marinduque Island). There are many collections from some of these provinces, and without doubt search would prove the species to be present in all the others. In addition there are collections from Mindanao, Samar, Panay, Cebu, Negros, Palawan, and Basilan Islands, and no doubt the species would be found in all other islands of any size. No other species, save, of course, *Macrotermes gilvus,* the mound builder, and perhaps *Neotermes malatensis,* has so wide a distribution in the Archipelago.

Biology.—This species, like others of the genus studied in Ceylon and elsewhere, is a day forager. Its armies extend for a distance of at least several hundred yards, consisting of five or six lines of workers, flanked by an outer cordon of soldiers. They gather fragments of decayed leaves, possibly of fungus, which are taken to the nest—a large, dark brown to black structure at the base of a tree giving off an unpleasant odor. This species, whose nests are to be found by careful search almost on the outskirts of Manila, offers a remarkable opportunity for a study of social organization, caste determination, feeding methods, behavior, etc.

Genus GRALLATOTERMES Holmgren

This genus, separated as a subgenus by Holmgren (1912) for *Termes grallator* Desneux, seems to consist of relict species—*G. grallator* (Desneux) in New Guinea, *G. grallatoriformis* (Holmgren) in the Anamalai Hills of northern India (1917), *G. weyeri* Kemner (1913) in Amboina, *G. admirabilus* Light (1930) in Negros, Panay, and Mindanao, and *G. splendidus* sp. nov. in the depths of a swamp about Lake Casili, near Arayat, Pampanga. All collections of the Philippine species were from virgin forest, which probably explains their restricted distribution.

Oshima's species assigned to the subgenus *Grallatotermes, Eutermes* (*G.*) *brevirostris* from the Caroline Islands (1917) and *Eutermes* (*G.*) *luzonicus* and *E.* (*G.*) *panayensis* from the Philippines, as also Snyder's *N.* (*G.*) *oceanicum* from the Santa Cruz Archipelago, belong to the genus *Nasutitermes,* the *Eutermes* sen. str. of Holmgren.

Key to the soldiers of the two Philippine species of Grallatotermes Holmgren.

1. Head black or black-brown; body, antennæ, and legs light brown. *G. splendidus* sp. nov.
   Head, antennæ, and abdominal tergites dark brown; thorax and legs bright yellow; sternites very pale brown, lateral abdominal membranes white .... *G. admirabilus* Light.

4. **GRALLATOTERMES ADMIRABILUS Light. Text fig. 5.**

Alate.—Head black, median areas of thoracic sterna, legs, and distal segments of antennæ yellow; other parts light or dark brown; clypeus lighter than frons, about one-fourth as long as broad; segment III of antennæ about as long as II; fontanel white, conspicuous, a three-rayed fissure; ocelli conspicuous, separated from eye by less than their short diameter, eyes very large, strongly projecting; costal stripe inconspicuous.

Measurements in millimeters of alates of Grallatotermes admirabilus Light.

Length with wings, male	18.00
Length with wings, female	19.00–21.00
Body length, male	9.00
Body length, female	10.00
Length of forewing	15.20–16.20
Length of forewing with scale	17.00
Width of head with eyes	1.90
Width of head between eyes	1.08
Length of head	1.80
Head length to clypeofrontal suture	1.20–1.25
Width of postclypeus (maximum)	0.76–0.80
Diameter of compound eye	0.72
Length of ocellus	0.225
Length of fontanel	0.16
Length of pronotum	0.97–1.00
Width of pronotum	1.80

Soldier (*fig. 5*).—Head, antennæ, and abdominal sclerites black-brown with reddish tinge; rostrum distally dark reddish; thorax and legs bright yellow, ventral side of abdomen white to light yellow-brown.

Head and rostrum shaped as in fig. 5, dorsal profile concave and slightly sinuous; rostrum short, thick conical (fig. 5, *b*), uplifted, arising by a very broad base from the otherwise

declivitous frons. Antennæ of thirteen segments, considerably longer than head with rostrum.

Measurements in millimeters of soldiers of Grallatotermes admirabilus Light.

Length	4.50–5.50
Length of head to posterior margin of antennal foveola	1.25
Length of head with rostrum	1.80
Width of head	1.20
Width of pronotum	0.72
Length of pronotum	0.42
Length of hind femur	1.68
Length of hind tibia	2.10

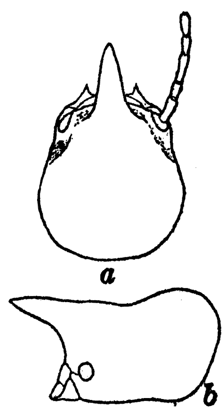


FIG. 5. *Grallatotermes admirabilus* Light, head of soldier; *a*, dorsal view; *b*, lateral view.

Distribution and biology.—As reported (Light, 1930) this species has been taken once in Panay, twice in Negros, and twice on the Cotabato coast of Mindanao. A large carton nest on a tree trunk was reported in two cases (Panay and Negros). Aside from this, nothing is known of the biology of this striking species.

5. **GRALLATOTERMES SPLENDIDUS** sp. nov. Text fig. 6.

Alate.—Unknown.

Soldier (*fig. 6*).—Head black, with a deep purplish effect, to dark mahogany; anterior half of rostrum reddish; antennæ and pronotum brown; other tergites light brown; sternites and legs brownish yellow.

Head large; head and rostrum shaped as in fig. 6. Rostrum short, thick-based, somewhat elevated; dorsal profile concave but less so than in *G. admirabilus* Light, not sinuous; mandibles thornlike, distal portion bearing a faint vestige of a tooth just below the middle.

Antennæ of thirteen segments, shorter than in *G. admirabilus,* slightly longer than head with rostrum; segment III much elongated, more than twice as long as II; III longer than IV; V to XIII subequal, about one-seventh shorter than III. Body relatively weakly chitinized, abdomen long and relatively slender (not "humped" as in *G. admirabilus*).

Measurements in millimeters, and indices, of a typical soldier of Grallatotermes splendidus sp. nov., from the type collection, No. 238.

Length of head and rostrum	1.95
Length of head without rostrum	1.33
Length of rostrum	0.62
Length of antennal segment III	0.20
Length of antennal segment IV	0.14
Head production	0.27
Height of head	1.00
Width of head	1.41
Length of fore tibia	1.20
Head index	1.06
Head-rostrum index	0.47
Head production index	0.22
Leg elongation index	0.90

Systematic position.—This striking species, known only from soldiers and workers, differs from the four other species of the genus in (*a*) its larger size, (*b*) its shorter antennæ and legs, and (*c*) the elongated, relatively slender abdomen of both soldiers and workers.

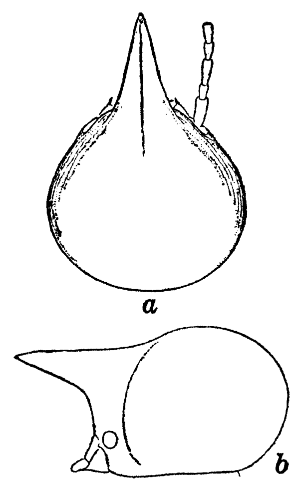


FIG. 6. *Grallatotermes splendidus* sp. nov., head of soldier; *a*, dorsal view; *b*, lateral view.

Distribution and biology.—This species was taken by Light and McGregor from a large carton nest on the rotten stub of a small tree in the swampy jungle near the southwest shore of Lake Casili. This island of undisturbed lowland forest, located just across the Pampanga River from Arayat, Luzon, merits careful study from a faunal, floristic, and ecologic angle. No record was made of covered ways, but the relatively weakly chitinized bodies of workers and soldiers and the relatively short legs make it very improbable that they are day foragers.

Genus NASUTITERMES Banks

Subgenus HAVILANDITERMES Light, 1930

6. NASUTITERMES ATRIPENNIS (Haviland). Text fig. 7.

Alate.—Dark brown; wings brown-black, very thickly haired; postclypeus much shorter than half its width. Fontanel large,

three-cornered. Ocellus separated from eye by its short diameter or more. (Diagnosis based on Holmgren's description of *Eutermes atripennis* Haviland.)

Soldier (*fig. 7*).—Head light brownish yellow; rostrum darker distally, red-brown; tergites dark brown.

Head and rostrum shaped as in fig. 7; dorsal profile distinctly concave; rostrum long, thick, conical, strongly uplifted. Antennæ of fourteen segments.

Measurements in millimeters of a large and a small soldier of Nasutitermes atripennis (Haviland).

	Large soldier.	Small soldier.
Length of head	5.2	4.3
Length of head to posterior margin of antennal foveola	1.17	1.08
Length of head with rostrum	2.18	2.03
Width of head	1.30	1.12
Length of pronotum	0.27	
Width of pronotum	0.63	
Length of hind tibia	1.80	1.75
Length of abdomen	2.70	2.43

Subgenus NASUTITERMES sen. str. Banks

The species, most of them new, that are here allocated to this subgenus represent several very distinct types, which may ultimately be given subgeneric or generic rank. At present, however, the alates are but little known, and the relations of the species to the other species in the group are not sufficiently well known to allow satisfactory determination of subgeneric characters.

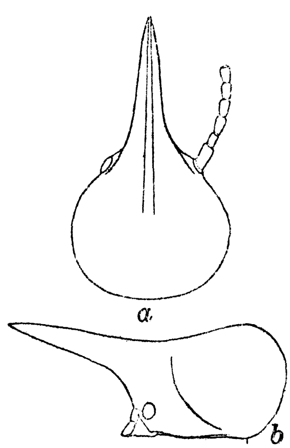


FIG. 7. *Nasutitermes atripennis* (Haviland), head of soldier; *a*, dorsal view; *b*, lateral view.

The differentiation of species in this group presents difficult problems, especially when dependence must be made chiefly on soldier characters. Variation both within the same colony and between colonies is very great. Until very large collections are available, which will permit a determination of the nature, extent, and significance of intraspecific variation, the classification of these species must remain unsatisfactory and to some extent tentative. Oftentimes, however, the decisions are actually more justified than can be brought out by

any method of description as yet available. A certain intangible facies sets certain lots apart as a single species in spite of relatively great variation in size, in head shape, etc., and even in proportions. Such differences are brought out by the figures of *Nasutitermes gracilis* Oshima (fig. 8).

Key to the soldiers of the Philippine species of Nasutitermes Banks sen. str.

1. Head little produced behind, relatively short; without obvious constriction behind the antennæ (except *N. balintauacensis*) .... 2.
   Head much produced behind, relatively long, pyriform, with a constriction behind the antennæ (fig. 22, *a*) .... 15.
2. Rostrum conical, at least twice as thick at base as at middle (fig. 10, *b*) .... 3.
   Rostrum awl-shaped (cylindrical), less than twice as thick at base as at middle (fig. 18, *a*) .... 11.
3. Head yellow .... *N. gracilis* (Oshima).
   Head black, infuscated brown, or clear brown .... 4.
4. Head black, dark brown, or brown with infuscation; tip of rostrum typically red .... 5.
   Head brown .... 8.
5. Very small, head with rostrum less than 1.30 mm long; dorsal profile of head distinctly convex .... *N. mollis* sp. nov.
   Larger, head with rostrum more than 1.35 mm long (usually much more); head profile flat or sinuous .... 6.
6. Tergites well chitinized, dark brown; rostrum relatively short and thick, head-rostrum index less than 0.60 .... 7.
   Tergites weakly chitinized; pale yellowish brown; head sharply contracted in front; rostrum longer, head-rostrum index more than 0.60. *N. luzonicus* (Oshima).
7. Antennal foveolæ not visible in dorsal view; rostrum longer, more slender .... *N. simulans* sp. nov.
   Antennal foveolæ visible in dorsal view; rostrum shorter and thicker. *N. latus* sp. nov.
8. Tergites dark brown, strongly pigmented .... *N. panayensis* (Oshima).
   Tergites pale to yellow .... 9.
9. Larger; head, antennæ, etc., orange-brown .... *N. meridianus* sp. nov.
   Smaller; head light brown; antennæ and tergites light .... 10.
10. Tergites very pale; rostrum relatively narrow (fig. 15, *a* and *b*); from Luzon .... *N. oshimai* sp. nov.
    Tergites yellow; rostrum thick (fig. 16, *b* and *c*); from southern islands .... *N. chapmani* sp. nov.
11. Very small head, with rostrum less than 1.20 mm long; mandible with vestigial apical portion (fig. 17, *c*) .... *N. parvus* sp. nov.
    Large head, with rostrum more than 1.30 mm long; free apical portion of mandible relatively long and spinelike .... 12.
12. Larger; head with rostrum more than 1.60 mm long; head very broad, head index 1.05 or more; apical portion of mandible strongly outcurved (fig. 18, *c*) .... *N. rotundus* sp. nov.

Smaller; head with rostrum less than 1.55 mm long; head narrower, head index only slightly over 1.00; apical portion of mandible not strongly outcurved .... 13.

13. Anterolateral margins of head in dorsal view indented by slight but distinct constriction (fig. 19, *a*) .... *N. balintauacensis* (Oshima).
   No such indentation .... 14.
14. Head dark smoky brown, particularly at base of rostrum; tergites smoky brown; rostral hump very conspicuous (fig. 20, *e*). *N. taylori* sp. nov.
   Head light brown; tergites light yellow-brown; rostral hump not conspicuous .... *N. castaneus* (Oshima).
15. Rostrum long, head-rostrum index more than 0.70. *N. mcgregori* (Oshima).
   Rostrum short, head-rostrum index less than 0.50 .... 16.
16. Head brown, rostrum very dark at base, tergites dark, strongly chitinized; constriction very conspicuous (fig. 22, *a*). *N. constricticeps* sp. nov.
   Head orange to orange-brown; rostrum not darkened, at most reddish; tergites pale yellow or light brown, not strongly chitinized; constriction not very conspicuous .... 17.
17. Constriction conspicuous; anteroventral corners of head capsule flaring (fig. 23, *a*); mandible with oblique sides, apical portion about one-third as long as basal portion (fig. 23, *c*). *N. busuangæ* sp. nov.
   Constriction inconspicuous; anteroventral corners of head capsule not visible from above (fig. 24, *a*); mandible with nearly straight lateral side, its apical portion nearly as long as basal portion (fig. 24, *e*). *N. brevicornis* sp. nov.

7. NASUTITERMES GRACILIS (Oshima). Text fig. 8.

Eutermes (*Eutermes*) *gracilis* OSHIMA, 1916, 1920.
Eutermes minutus OSHIMA, 1917 (fide Oshima).
Eutermes (*Rotunditermes*) *culasiensis* OSHIMA, 1920.

Dealate (*fig. 8, a*).—Head brown, postclypeus and labrum pale yellow; antennæ light brown; pronotum brownish yellow; mesonotum pale yellowish white; metanotum pale yellow; thorax white with lines bordering sclerites; tergites chestnut-brown; sternites yellow to golden yellow with lateral brown areas around white muscle marks; head small, 1.25 mm wide through eyes; shaped as in fig. 8, *a*.

Fontanel conspicuous (fig. 8, *a*), whitish yellow, Y-shaped, flaring anteriorly; slightly longer than ocellus.

Ocellus elliptical, long diameter less than one-third diameter of eye; separated from eye by about one-half the short diameter of ocellus.

Eye large, projecting (fig. 8, *a*); separated from both upper and lower margin of head by about one-eighth its own diameter

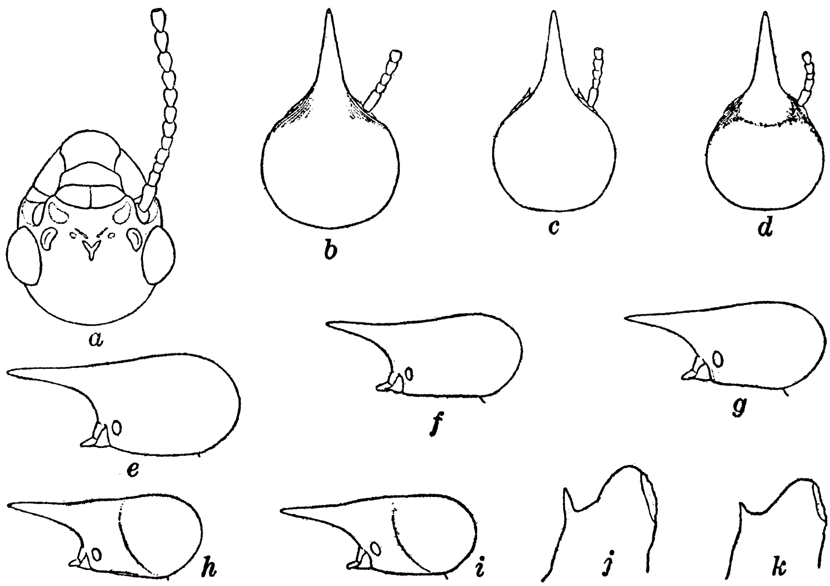


FIG. 8. *Nasutitermes gracilis* (Oshima); *a*, head of alate from Ilocos Norte in dorsal view; *b* to *d*, heads of soldiers in dorsal view to show variation (*b* from Palawan, *c* from Rizal, *d* from Ilocos Norte from same colony as *a*); *e* to *i*, heads of soldiers in lateral view to show variation (*e* from Mount Mariveles, Bataan; *f* from Panay; *g* from Mindanao; *h* from Ilocos Norte; *i* from Rizal); *j* and *k*, left mandibles of soldiers (*j* from Cotabato, the typical form; *k* from Panay, an extreme variant, probably abnormal).

and from posterior margin by about three-fifths its own diameter.

Antennæ of twelve or more segments, III shortest and narrowest, about one-half as wide as distal segments, weakly chitinized; V small or incompletely separated from VI; II and IV relatively short, subequal, wider than III or V (when separate), but narrower than more distal segments.

Measurements in millimeters of a dealate of Nasutitermes gracilis (Oshima), from collection 1236, from Palawan.

Length of body with head	5.98
Length of head	1.45
Length of head capsule	1.03
Width of head capsule	0.93
Width of head with eyes	1.25
Length of pronotum	0.61
Width of pronotum	0.04
Diameter of eye	0.49
Long diameter of ocellus	0.17
Short diameter of ocellus	0.13
Distance of ocellus from eye	0.03

Soldier (*fig. 8, b to k*).—Head yellow to orange; antennæ pale yellow-brown; distal two-thirds of rostrum reddish; body generally pale and slightly chitinized; tergites pale yellow-brown.

Head somewhat variable in shape (fig. 8, *b* to *i*), but about as broad as long with flattened or flatly rounded posterior border; rostrum long and narrow, especially in distal half; rostral hump absent (fig. 8, *f*) or negligible, lateral profile straight (fig. 8, *e*), faintly concave (fig. 8, *f*), or weakly sinuous (fig. 8, *h*); head typically depressed anteriorly and roundly elevated behind.

Mandible (fig. 8, *j* and *k*) different from that of soldiers of the *matangensis* group in its relatively small free portion and its distally extended molar region.

Measurements in millimeters, and indices, of extreme sizes of soldiers of Nasutitermes gracilis (Oshima), from collection 685, from Mount Mariveles, Bataan Province, Luzon.

Length of head and rostrum	1.74	1.68
Length of head without rostrum	1.09	1.05
Length of rostrum	0.65	0.63
Head production	0.30	0.30
Height of head	0.76	0.72
Width of head	1.20	1.10
Length of hind tibia	0.83	0.78
Head index	1.10	1.09
Head-rostrum index	0.60	0.60
Head production index	0.28	0.29

Variation.—This is a very widespread, variable species. So considerable was the variation in size and degree of coloration, accompanied in some cases by seeming differences in the shape of mandible of the soldier, that there were originally set aside three new species. Study of variations within groups showed that the characters used in separating these supposed species did not always hold in single collections. It has seemed wiser, therefore, to leave any finer taxonomic distinctions to later workers to whom more material is available.

The range of size is brought out by fig. 8, *b* to *i*, and by the measurements of soldiers from several colonies given below.

Certain colonies from the lower slopes of Mount Mariveles, Bataan Province, Luzon, have considerably darker color, the head being golden yellow to light orange with red rostrum. Here also the tergites are fairly well chitinized and light brown. These colonies are correspondingly larger (see measurements

below of soldier from collection 685), however, and there seems to be a direct correlation between size and color.

At the other extreme are small forms from Ilocos Norte (No. 1275), Rizal (No. 141), and Palawan (No. 122), measurements of soldiers of which are given below, which are much lighter in color and chitinization than are the soldiers of most of the colonies, and have narrower, somewhat square heads. However, changes in these directions with decreasing size seem characteristic of the nasutes of several species, and hence these differences have been disregarded here, especially since more typical colonies of *N. gracilis* have been found in all these localities.

Measurements of soldiers in millimeters, and indices, from various colonies of Nasutitermes gracilis (Oshima).

	Province.					
	Laguna.	Bataan.	Ilocos Norte.	Rizal.	Palawan.	Laguna.
Lot No.	141	670	1275	58	1227	964
Length of head and rostrum ..... mm	1.48	1.56	1.43	1.54	1.44	1.61
Length of head without rostrum .. mm	0.90	0.91	0.84	0.96	0.90	1.06
Length of rostrum ..... mm	0.58	0.65	0.59	0.58	0.54	0.55
Head production ..... mm	0.26	0.30	0.25	0.24	0.27	--------
Height of head ..... mm	0.56	0.67	0.54	0.69	0.60	--------
Width of head ..... mm	0.96	0.99	0.84	1.02	0.93	--------
Length of fore tibia ..... mm	0.75	0.69	0.60	0.69	0.72	--------
Head index	1.06	0.99	1.00	1.06	1.03	0.96
Head-rostrum index	0.65	0.71	0.70	0.61	0.63	0.51
Head production index	0.29	0.33	0.29	0.25	0.31	0.23
Leg elongation index	0.83	0.76	0.71	0.72	0.78	0.73

Systematic position.—This is the only Philippine nasute whose soldier has a yellow head and a conical rostrum. It seems most closely related to *N. javanicus* (Holmgren), but is distinctly larger.

Distribution and biology.—This is one of the common species, occurring twenty times in the collection from localities as far apart as Ilocos Norte Province, Luzon, on the one hand, and Sir J. Brooke Point, in southern Palawan, and Cotabato Province, Mindanao, on the other. Other regions represented are Rizal, Bataan, Laguna, and Tayabas Provinces in Luzon, Tablas Island, and Culasi in Antique Province, Panay. It is especially abundant on the slopes of Mounts Mariveles and Maquiling.

Nasutitermes gracilis builds extensive covered ways, over dead wood of trees and shrubs and even over deserted buildings. Taylor reported an exposed carton nest for a colony taken on Tablas Island and a subterranean carton nest for one taken at 300 meters' altitude on Mount Maquiling.

8. NASUTITERMES MOLLIS sp. nov. Text fig. 9.

Alate.—Unknown.

Soldier.—Head smoky yellow-brown behind; darker along sides and in front; rostrum proximally burnt umber, distally reddish; abdominal tergites pale smoky brown; nota pale yellow with faint smoky tinge; other parts pale whitish yellow. Head and rostrum shaped as in fig. 9, *a* and *b;* dorsal profile distinctly convex, with a concavity at base of rostrum due to a slight constriction. Head covered with a dense coat of slender whitish hairs. Antennæ of eleven segments, about two-thirds length of head with rostrum.

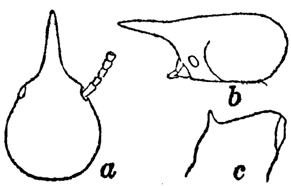


FIG. 9. *Nasutitermes mollis* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

Measurements in millimeters, and indices, of typical soldiers of Nasutitermes mollis sp. nov., from the type collection, No. 1131, from Cotabato Province, Mindanao.

Length of head and rostrum	1.23	1.23	1.29
Length of head without rostrum	0.78	0.75	0.81
Length of rostrum	0.45	0.48	0.48
Head production	0.22	0.22	0.24
Height of head	0.45	0.43	0.51
Width of head	0.74	0.72	0.81
Length of tibia	0.54	0.48	0.54
Head index	0.95	0.96	1.00
Head-rostrum index	0.58	0.64	0.59
Head production index	0.28	0.29	0.27
Leg elongation index	0.69	0.64	0.67

Distribution and biology.—The single collection (No. 1131) was taken by E. H. Taylor "in a dead tree" on Luan River, Cotabato Province, Mindanao.

Systematic position.—The minute size and small number of antennal segments associated with the heavy hairing of the head and the relatively long, narrowly conical rostrum set this species apart from all other Oriental species of this genus.

9. NASUTITERMES LUZONICUS (Oshima). Text fig. 10.

Eutermes (*Grallatotermes*) *luzonicus* OSHIMA, 1914, 1916, 1920.
Eutermes (*Eutermes*) *manilensis* OSHIMA, 1916.
Eutermes (*Eutermes*) *las-piñasensis* OSHIMA, 1920.
? *Eutermes* (*Trinervitermes*) *menadoensis* OSHIMA, 1920.

This is the most widespread and the most commonly encountered of the nasute termites of the Philippines. It seems

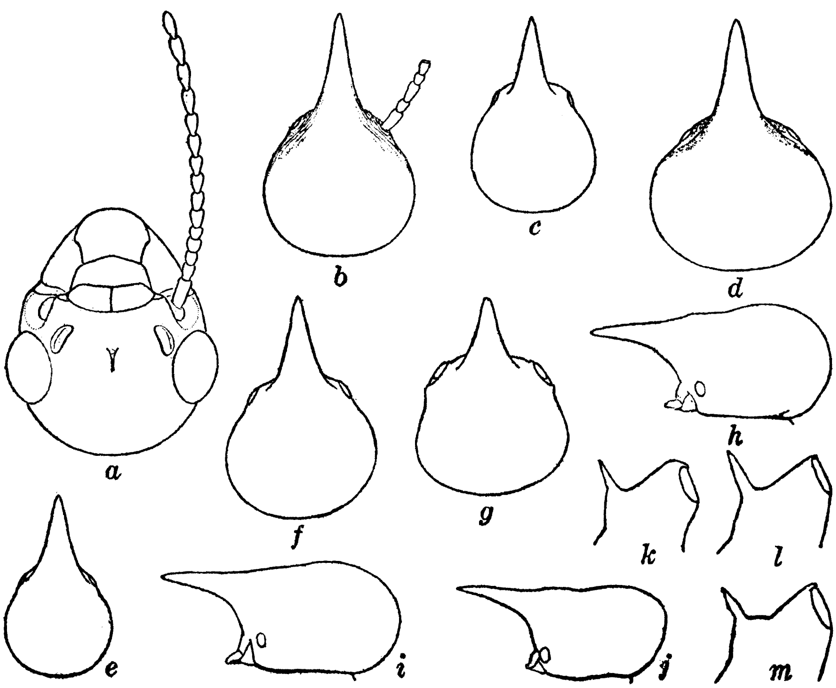


FIG. 10. *Nasutitermes luzonicus* (Oshima) ; *a*, head of alate in dorsal view; *b* to *g*, heads of soldiers in dorsal view to show variation in size and proportions (*e* to *g*, individuals from the same colony, No. 113, from Rizal; *g* is probably abnormal) ; *h* to *j*, heads of soldiers in lateral view to demonstrate variations in dorsal profile and size of rostrum; *k* to *m*, left mandibles of soldiers to illustrate variations.

also to be the most variable, perhaps due to the large collections available for study. There follows an attempt at a diagnosis of the alate and soldier. These should be considered in the light of the wide variation discussed below. The description of the alate is somewhat more detailed as it has not been previously described.

Alate (*fig. 10, a*).—About 8 mm long without wings, 15 mm with wings; forewing about 14 mm long. Head dark mahogany

brown, nota yellowish, abdominal tergites brown; abdominal sternites yellow with lateral brown areas, wings pale yellowish brown, veins light brown, radius sector bordered posteriorly by a narrow dark brown stripe separated by a narrow white stripe from a golden zone, which shades into the membrane color.

Head (fig. 10, *a*) about 1.5 mm wide through the eyes, not greatly narrowed in front. Eyes relatively large, about 0.55 mm in long diameter, but not strongly projecting. Ocellus about one-third as long as eye, separated from eye by about half its short diameter; long axis of ocellus making an angle of about 45° with the long axis of head; short axis of ocellus nearly vertical, making chitin of head seem to overlie its inner margin. Head with curved, raised, transverse ridge joining ocelli, succeeded posteriorly by a distinct concavity within the anterior half of which the slender, slitlike, yellowish to white fontanel is located in a narrow longitudinal ridge. Antennæ of fifteen segments; segments II and III subequal in length. Pronotum faintly concave posteriorly. Diagnosis based on collection 706 from Cavite.

Measurements in millimeters of a typical alate of Nasutitermes luzonicus (Oshima), from collection 706, from Cavite, Luzon.

Length over all	15.40
Length of forewing	14.00
Width of forewing	3.60
Length of head	1.80
Length of head capsule	1.11
Width of head capsule	1.14
Width of head with eyes	1.50
Length of pronotum	0.70
Width of pronotum	1.25
Long diameter of eye	0.55
Short diameter of eye	0.45
Long diameter of ocellus	0.20
Short diameter of ocellus	0.14
Distance of ocellus from eye	0.06

Soldier (*fig. 10, b to m*).—Head mahogany red (brown in fixative) to black; distal half of rostrum usually reddish, but black in some colonies; antennæ light brown; body weakly chitinized; tergites pale yellow-brown to light brown, depending upon degree of chitinization.

Head variable in shape as brought out under variation, but with certain underlying characteristics; head relatively broad (fig. 10, *b*), sides rounded; posterior margin flatly rounded;

head distinctly narrowed in front, its sides in dorsal view rounding into the sides of the rostrum. Dorsal profile as seen in lateral view typically sinuous (fig. 10, *h*); a shallow groove, marking morphological junction of head and rostrum, running from front of head just above mandibles obliquely upward and backward, passing in front of antennæ and crossing head some distance behind the level of the antennal foveolæ, where it makes a slight concavity; a slightly raised area between this concavity, in dorsal profile, and the front of the head (the "rostral hump," fig. 10, *h*); rostrum constricted near its base, making a weak concavity between rostral hump and dorsal margin of free portion of rostrum (fig. 10, *j*); dorsal margin of rostrum usually weakly convex, due to slightly uplifted position of free portion as a whole and slight depression of distal third of free portion.

Antennæ of thirteen segments, nearly as long as head with rostrum; segment IV shortest, III nearly twice as long as II.

Measurements in millimeters, and indices, of typical soldiers of Nasutitermes luzonicus (Oshima).

	No. 706.	Paratype.
Length of head and rostrum	1.74	1.56
Length of head without rostrum	1.14	0.99
Length of rostrum	0.60	0.57
Head production	0.3	0.30
Height of head	0.82	0.66
Width of head	1.17	1.02
Head index	1.02	0.99
Head-rostrum index	0.53	0.57
Head production index	0.28	0.30

Worker.—Head dark brown; tergites pale.

Distribution and variation.—*Nasutitermes luzonicus* is by far the commonest and most widespread nasute termite of the Philippines and perhaps the commonest termite species. We have 188 collections of the species, including one from Itbayat Island in the Batanes, north of Luzon, nearer to Formosa than to Luzon, and one from Sitankai Island, in the southernmost Tawitawi group, within a few miles of northern Borneo. The others are from many of the islands and provinces between. It is most abundant in Luzon, where it is the only abundant nasute species, yet it has been taken on all the principal islands, save Palawan; namely, Mindoro, Samar, Panay, Negros, Cebu, Leyte, and on several of the smaller ones, as Marinduque, Romblon, Tablas, Dinagat, Basilan, and Jolo. In the Visayas it is more or less

completely replaced as the common nasute species by the light brown *N. panayensis* (Oshima) described below.

The soldiers of *N. luzonicus* show an extremely wide variation, as is brought out by fig. 10, *b* to *g*. So great is this variation that with incomplete collections it would be natural, as the senior author's earlier manuscripts attest, to describe these variants as separate species, as Oshima has done. When, however, one finds the extremes of such variation within a single colony, as is often the case, it becomes apparent that it is of no taxonomic significance.

So extreme is this variation that it becomes almost impossible to diagnose the species. Were it not that this is the only common dark-headed species of *Nasutitermes* and, indeed, the only one save *N. mollis, N. simulans,* and *N. latus,* which are smaller and known only from Mindanao and Palawan, its identification would be extremely difficult.

This variation affects size, color of head, degree of chitinization, and color of abdominal sclerites, and especially the relative width of head and the shape and relative length of rostrum. Collections from certain colonies seem consistently black headed, but some contain dark- and lighter-headed individuals, while in others all are lighter headed. In dark individuals the reddish coloration of the distal portion of the rostrum tends to be obscured. In very light individuals the distal portion of the rostrum is yellowish, rather than red.

The head length with rostrum ranges from somewhat less than 1.4 mm (fig. 10, *d*) to slightly more than 1.8 (fig. 10, *e*). When this shorter length is combined, as is usually the case, with a narrower head (fig. 10, *e*) the size difference is striking. The smallest individuals are as a rule lighter and have fewer (12) antennal segments. This suggests that we are dealing here with soldiers which metamorphosed in an earlier instar. Intergrades complicate the situation, which must wait for solution upon careful studies of the life cycle and the developing colony. The University of the Philippines, situated in the center of abundance of the species, is well located for such a study.

The range in size and in relative width of head is illustrated in fig. 10, *b* to *f*. Head width in the individuals measured ranges from 0.78 to 1.26 mm and the index obtained by dividing head width by head length with rostrum varies from 0.48 to 0.73. It is interesting to note that the maximum spread for this index was found by measuring the extremes of variation

within a single colony (fig. 10, *e* and *f*). In spite of the great differences in this index between extreme variants, the index is nearly always between 0.60 and 0.65 for what may be called the typical soldiers (fig. 10, *b*), which make up by far the larger part of most collections.

While, therefore, there is a very striking range of variation in head size and proportions, the ordinary soldiers present a fairly constant shape and size of head, represented in fig. 10, *b* and *i*. Furthermore, while in some cases the variation seems to be between colonies, in those collections which are fair samples it is found to be intracolonial. Thus, in colony 113, from Balintawac near Manila, four individuals were selected that ranged from 1.38 to 1.68 in length of head with rostrum, from 0.78 to 1.10 mm in width of head, and from 0.48 to 0.73 in ratio of width of head to length of head with rostrum. It should be said, however, that the individual with the ratio of 0.73 was plainly abnormal (fig. 10, *g*) as brought out by the blunt, rough rostrum, the peculiarly broad front of the head, and other features. Another soldier in the same collection, apparently normal, had an index of 0.68.

Not only does the head vary in size, shape, and proportions as seen in dorsal view, but the profile in lateral view shows much variation (fig. 10, *h* to *j*). This involves several factors; namely, (*a*) the relative height of the head itself in front and behind (fig. 10, *h* and *j*), (*b*) the relative prominence of the rostral hump (fig. 10, *h* and *i*), and (*c*) the direction of the rostrum, whether slightly uplifted as a whole (fig. 10, *j*), depressed (fig. 10, *h*), or neither (fig. 10, *i*). The rostral hump gives the characteristic sinuous appearance to the profile of this species. The profile becomes distinctly convex when the hump is inconspicuous and the rostrum straight or uplifted (fig. 10, *i*).

Finally, the rostrum itself varies in relation to the head length, in its thickness throughout or at the base, and in its shape. In the more typical individuals the sides of the head curve into the rostrum in dorsal view and the rostrum beyond the base is clearly narrowed, giving it concave sides in dorsal view (fig. 10, *b*) and a concave lower margin in lateral view (fig. 10, *i*). Certain individuals, however, show a much-narrowed, slender rostrum (fig. 10, *j*). In others this basal constriction is lacking, giving the rostrum a coarser appearance, its margins in dorsal view being nearly straight lines (fig. 10, *c*), the concavity of the ventral margin being very slight. Again,

the rostrum varies as to the distal portion, in some being straight, but more commonly somewhat bent down as in fig. 10, *h*, or bent up as in fig. 10, *j*. Much of the apparent variation in length of rostrum is due to the fact that a thick rostrum looks shorter in either dorsal or lateral view.

Systematic position.—Its range, from within sight of Formosa to within sight of Borneo, would suggest that this species would prove to be the same as a Formosan or Bornean species. That it would prove to be cospecific with a Formosan termite seems unlikely, because of the depth between the Batanes and Formosa and the correlated wide differences in their faunæ and floræ. It differs from *N. takasagoensis*, also a member of the *matangensis* group, which it approaches most closely among the Formosan species, in its much larger alate and in the much more narrowed rostrum.

Nasutitermes luzonicus will probably be found in Borneo, but it has not been identified with any East Indian species. From both *N. matangensis* (Holmgren) and *N. matangensiformis* (Holmgren) it differs in the typically much narrower head and rostrum of the soldier and its much darker color.

Biology.—The conspicuous brown carton nests of this species, built usually on trees, are a characteristic element of the rural or village scene in Luzon. Its rather broad light brown to black-brown runways, constructed of wood fragments and fæces, connect the nests with the ground and with the dead wood on which it feeds. Runways are occasionally found on houses, and rarely it attacks the wood of houses, usually when, as on the outskirts of Manila, for example, the clearing away of trees has reduced the amount of available natural wood.

That the secretions of the cephalic glands furnish a fairly effective defense against true ants seems indicated by the reaction of ants into whose opened nests, or near the openings of whose nests, soldiers and workers were thrown. Workers are sometimes carried away by ants, but soldiers almost never; and ants exhibit signs of disturbance, seemingly of fear apparently induced by an odor from the termites. Ants that do pick up termites seem distressed by secretions, as indicated by vigorous wiping of their mandibles.

10. NASUTITERMES SIMULANS sp. nov. Text fig. 11.

Alate.—Unknown.

Soldier.—Head chestnut, lightest at level of antennæ; proximal half of rostrum dark smoky brown, distal half lighter, somewhat reddish; tergites, including nota, smoky brown; sternites very pale yellow-brown; lateral membranes transparent white; antennæ light brown; other parts pale yellow.

Head and rostrum shaped as in fig. 11, *a* to *d*. Rostral hump prominent with a slight constriction at its base; head considerably narrowed in front; antennal foveolæ not visible in dorsal view; head with three or four prominent hairs.

Antennæ of thirteen segments, rather less than length of head with rostrum; segment III much longer than II; IV and I about as long as II, not always completely separated.

Abdomen relatively long and slender, not humped.

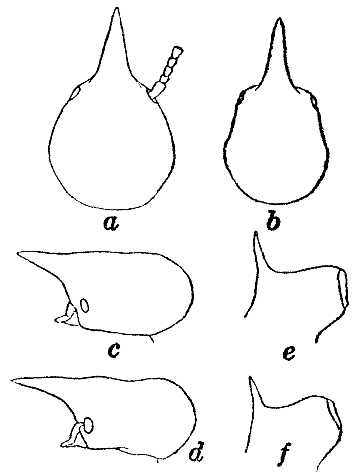


FIG. 11. *Nasutitermes simulans* sp. nov.; *a* and *b*, heads of two soldiers from the same colony, in dorsal view, to show range of variation; *c* and *d*, heads of two soldiers from the same colony, in lateral view, to show range of variation; *e* and *f*, left mandibles of soldiers.

Measurements in millimeters, and indices, of soldiers of Nasutitermes simulans sp. nov., from the type collection, No. 1183, from Cotabato Province, Mindanao.

Length of head and rostrum	1.47	1.39	1.53
Length of head without rostrum	1.02	0.91	0.99
Length of rostrum	0.45	0.48	0.54
Head production	0.30	0.27	0.35
Height of head	0.60	0.60	0.67
Width of head	0.90	0.84	0.99
Length of fore tibia	0.78	----------	0.78
Head index	0.88	0.92	1.00
Head-rostrum index	0.44	0.53	0.55
Head production index	0.29	0.36	0.33
Leg elongation index	0.77	0.76	0.79

Variation.—Color varies from dark opaque chestnut in the large individuals to lighter brown with a yellowish tinge in some

of the smaller ones. Rather wide variation as to width and shape of head in dorsal view, as also in lateral profile and shape of rostrum, is brought out by fig. 11, *a* to *d*.

Systematic position.—*Nasutitermes simulans* is apparently most closely related to *Eutermes* (*E.*) *javanicus* Holmgren, but differs from it materially in its larger size and darker color.

Distribution and biology.—The single collection, No. 1183, was made by E. H. Taylor, in "rotten wood" on Malanipa Island, Cotabato Province, Mindanao. Nothing is known of its biology.

11. NASUTITERMES LATUS sp. nov. Text fig. 12.

Alate.—Unknown.

Soldier.—Head chestnut; rostrum proximally dark smoky, distally reddish; antennæ shading from light red at base to yellow at tip; tergites and nota smoky brown, pronotum darkest; sterna very pale brown; other parts yellowish.

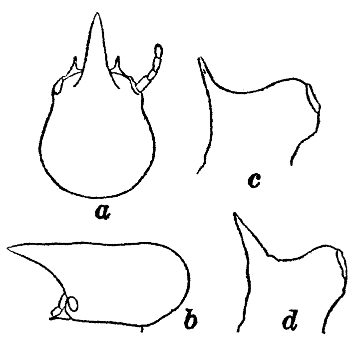


FIG. 12. *Nasutitermes latus* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c* and *d*, left mandibles.

Head and rostrum as in fig. 12, *a* and *b;* rostrum short, blunt, relatively narrow at base; rostral hump low but distinct; head broad at level of antennæ; antennal foveolæ exposed in dorsal view; head with three or four scattered, long, slender hairs.

Antennæ of thirteen segments; segments IV and V shortest, subequal; III longer.

Abdomen relatively short and broad, somewhat humped.

Measurements in millimeters, and indices, of soldiers of Nasutitermes latus sp. nov., from the type collection, No. 1206, from Sir J. Brooke Point, Palawan.

Length of head with rostrum	1.39	1.41	1.42
Length of head without rostrum	0.93	0.95	0.93
Length of rostrum	0.46	0.46	0.49
Head production	0.24	0.20	0.19
Height of head	0.61	0.68	0.67
Width of head	0.90	0.91	0.90
Length of femur	0.90	0.90	0.93
Length of hind tibia	1.02	1.08	1.03
Length of fore tibia	0.73	0.78	----------
Head index	0.97	0.96	0.97
Head-rostrum index	0.65	0.64	0.63
Head production index	0.27	----------	----------

Systematic position.—*Nasutitermes latus* differs from *N. javanicus* Holmgren in the same way as does *N. simulans* sp. nov. From *N. simulans*, which it resembles in color scheme and general size, it differs most strikingly in its generally broader head, the broad flat anterior portion of head making antennal foveolæ visible in dorsal view (fig. 12, *a*), and in its shorter rostrum. Other differences are the greater height of head, lower rostral hump, and the shorter, thicker abdomen.

Distribution and biology.—The single collection was taken from rotten wood at Sir J. Brooke Point, Palawan, by E. H. Taylor. Nothing else is known of its biology.

12. NASUTITERMES PANAYENSIS (Oshima). Text fig. 13.

Eutermes (*Grallatotermes*) *panayensis* OSHIMA, 1920.
Eutermes (*Ceylonitermes*) *mcgregori* OSHIMA, 1920 (not of Oshima, 1916).

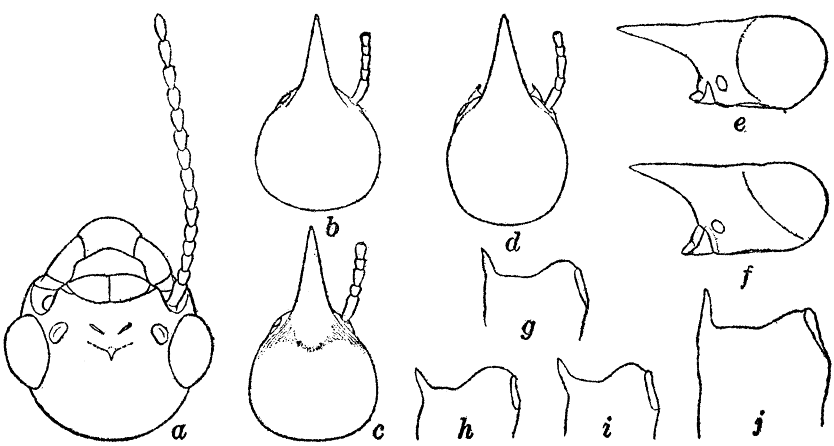


FIG. 13. *Nasutitermes panayensis* (Oshima); *a*, head of alate in dorsal view; *b* to *d*, heads of soldiers in dorsal view (*b* from an autotype from Culasi, Panay; *c* from a specimen from Tibiao, Panay, labeled by Oshima "*Ceylonitermes Mcgregori*" from which, of course, it differs very widely; *d* from an abnormal soldier with thick rostrum, taken in Negros); *e*, head of typical soldier in lateral view; *f*, head of abnormal soldier (same as *d*) in lateral view; *g* to *j*, left mandibles of soldiers (*j* from abnormal soldier *c* and *f*).

Alate (*fig. 13, a*).—Very similar to *N. luzonicus*. Head consistently lighter, slightly smoky light reddish brown; antennæ yellow-brown, frontal region very light brown; postclypeus light yellow-brown; tergites dark brown, darker than in *N. luzonicus*. Fontanel short, nearly triangular (fig. 13, *a*), much shorter than that of *N. luzonicus*. Otherwise as in *N. luzonicus*.

Measurements in millimeters of a typical alate of Nasutitermes panayensis (Oshima), from collection 167, from Cebu.

Length over all	15.5
Length of forewing	13.6
Width of forewing	3.7
Length of head	1.66
Length of head capsule	1.14
Width of head capsule	1.14
Width of head with eyes	1.50
Length of pronotum	0.84
Width of pronotum	1.32
Long diameter of eye	0.55
Short diameter of eye	0.50
Long diameter of ocellus	0.18
Short diameter of ocellus	0.13
Distance of ocellus from eye	0.04

Soldier (*fig. 13, b to j*).—Head much like typical *N. luzonicus* in shape, but never as wide as in wider individuals of *N. luzonicus;* with similar variations as to head profile. Rostrum somewhat longer, more slender distally, and more pointed. Head consistently light brown; tergites dark smoky brown, darker than head, and darker than tergites of *N. luzonicus*, which are much lighter than head. Left mandible (fig. 13, *g* to *i*) with short free portion; a depression between it and the molar surface shallow; lateral and medial surfaces nearly straight.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes panayensis (Oshima), from collection 167, from Cebu.

Length of head and rostrum	1.59
Length of head without rostrum	1.04
Length of rostrum	0.55
Head production	0.26
Height of head	0.68
Width of head	0.99
Length of fore tibia	0.84
Head index	0.95
Head-rostrum index	0.53
Head production index	0.25
Leg elongation index	0.81

Worker.—Much like *N. luzonicus*, but head lighter, tergites darker; head light brown, tergites smoky brown.

Variation.—Variation is much less noticeable in *N. panayensis* than in *N. luzonicus*. A paratype collection from Oshima, collected by McGregor at Culasi, Panay, shows the greatest range of variation noted, brought out by measurements below. In spite

of differences in size, the indices show the proportions to be very similar.

Measurements in millimeters, and indices, of smallest and largest soldiers of Nasutitermes panayensis (Oshima), in paratype collection 1528, from Culasi, Panay.

Width of head	0.81	0.91
Length of head with rostrum	1.36	1.52
Length of rostrum	0.49	0.57
Length of head capsule	0.87	0.96
Head index with rostrum	0.59	0.60
Head index without rostrum	0.93	0.95+
Rostral index	0.57	0.59

A single soldier in the same vial with a young colony of *N. chapmani* has been referred to this species because of the obvious similarities in many characters; such as, color of head and pigmentation of sclerites. It differs in having a short, basally thickened rostrum (fig. 13, *d* and *f*), which led to its being considered at first as representing a new species. The mandible also is very large with the free portions differently directed (fig. 13, *j*). This apparently aberrant soldier represents the greatest extreme of variation so far encountered if it is normal variation.

Measurements in millimeters, and indices, of an abnormal soldier of Nasutitermes panayensis (Oshima).

Length of head and rostrum	1.56
Length of head without rostrum	1.05
Length of rostrum	0.51
Head production	0.30
Height of head	0.66
Width of head	0.96
Length of fore tibia	0.99
Head index	0.91
Head-rostrum index	0.49
Head production index	0.29
Leg elongation index	0.95

Distribution and biology.—This, the common nasute termite of the Visayas, is represented in the collection by forty vials, which might easily have been four hundred. These collections are from the following islands and provinces: Marinduque Island, Tablas Island, Romblon Island, Panay, Negros, Cebu, Camasa Island, Leyte, and Zamboanga. The species is extremely common on Cebu and Negros Islands, and probably elsewhere, where it presents the same picture as does *N. luzonicus* in Luzon,

being extremely common in and about the cultivated, thickly populated areas. Its brown runways and carton nests are common sights on bamboo, coco palm, mango, and the other common trees of the region; also on fence posts, telephone poles, and houses. However, it seems to differ from its northern counterpart in its propensity to build over houses and attack decaying wood in them.

Systematic position.—*Nasutitermes panayensis* is close to *N. luzonicus* from which it differs chiefly in color of soldier and alate. The head of the soldier is narrower on the average and the rostrum narrower distally and more sharply pointed. The alates of the two species are very close, but that of *N. panayensis* is much lighter and averages somewhat smaller.

13. **NASUTITERMES MERIDIANUS** sp. nov. Text fig. 14.

Alate (*fig. 14, a*).—Very close to the alate of *N. luzonicus;* pronotum somewhat darker, perhaps; fontanel small, inconspicuous (often variable, however, in *N. luzonicus*). Otherwise as in *N. luzonicus.*

Measurements in millimeters of a typical alate of Nasutitermes meridianus sp. nov., from the type collection, No. 313, from Zamboanga Province, Mindanao.

Length over all	15.2
Length of forewing	13.4
Width of forewing	3.4
Length of head	1.65
Length of head capsule	1.20
Width of head capsule	1.30
Width of head with eyes	1.57
Length of pronotum	0.74
Width of pronotum	1.32
Long diameter of eye	0.56
Short diameter of eye	0.48
Long diameter of ocellus	0.20
Short diameter of ocellus	0.14
Distance of ocellus from eye	0.06

Soldier (*fig. 14, b to i*).—Head orange-brown; rostrum darker at base, distally reddish; antennæ, thorax, and abdominal tergites yellow with brownish tinge; legs yellow.

Head and rostrum shaped as in fig. 14, *b* and *e*. Dorsal profile as in *N. luzonicus;* mandible variable (fig. 14, *f* to *i*), but usually with relatively long free portion; lateral margin slightly oblique; anterior sinus relatively short and deep; molar surface short, succeeded proximally by a short flattened area, beyond which the inner margin is somewhat concave.

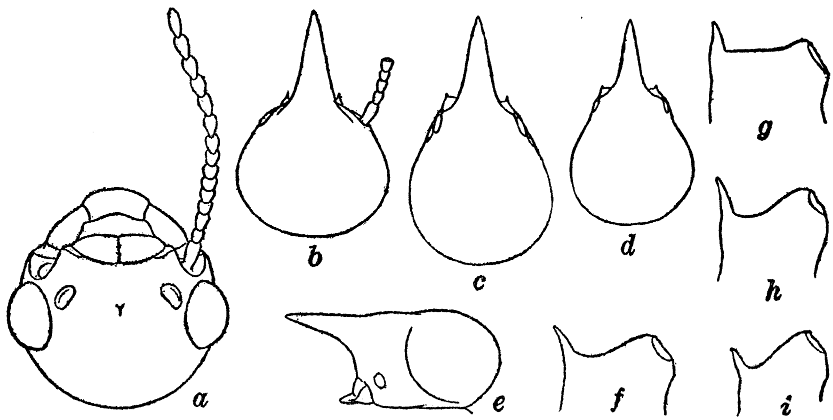


FIG. 14. *Nasutitermes meridianus* sp. nov.; *a*, head of alate in dorsal view; *b* to *d*, heads of soldiers in dorsal view, to show range in size and proportions, all from Palawan; *e*, head of soldier in lateral view; *f* to *i*, left mandibles of soldiers to show variation.

Antennæ of thirteen segments, nearly as long as head with rostrum.

Measurements in millimeters, and indices, of a large soldier of Nasutitermes meridianus sp. nov., from collection 313, from Jolo.

Length of head and rostrum	1.80
Length of head without rostrum	1.14
Length of rostrum	0.66
Head production	0.30
Height of head	0.78
Width of head	1.26
Length of fore tibia	1.14
Head index	1.10
Head-rostrum index	0.56
Head production index	0.26
Leg elongation index	1.00

Measurements in millimeters, and indices, of soldiers of Nasutitermes meridianus sp. nov., with narrower heads than those of the type collection, No. 313.

Length of head and rostrum	1.80	1.71
Length of head without rostrum	1.16	1.05
Length of rostrum	0.64	0.66
Head production	0.33	0.30
Height of head	0.76	0.66
Width of head	1.02	1.08
Length of femur	1.19	1.07
Length of hind tibia	1.33	1.33
Head index	0.95	1.02
Head-rostrum index	0.61	0.63
Head production index	0.30	0.30

Measurements in millimeters, and indices, of soldiers of Nasutitermes meridianus sp. nov., with smaller head capsules and mandibles, from collection 1225, Palawan.

Length of head and rostrum	1.51	1.51
Length of head without rostrum	0.93	0.93
Length of rostrum	0.57	0.58
Head production	0.24	0.24
Height of head	0.58	0.55
Width of head	0.93	0.93
Length of femur	0.78	0.73
Length of hind tibia	1.16	1.07
Length of fore tibia	0.84	0.78
Head index	1.00	1.00
Head-rostrum index	0.62	0.62
Head production index	0.26	0.26

Variation.—Very different head types are encountered in the same collection, illustrated by fig. 14, *b* and *c*. That these are not two soldier classes is indicated, however, by intergrading individuals (fig. 14, *d*).

Systematic position.—*Nasutitermes meridianus* belongs to the *matangensis* group and is one of a group of very closely related Philippine species including *N. luzonicus* and *N. panayensis*. In soldier characters it is quite distinct from *N. matangensis* and *N. matangensiformis* with types of which we have compared it. From the former it differs in its narrower head, relatively longer rostrum, etc.; and from the latter, which it approaches more closely, it differs in being larger and in the lower antennal hump, etc. From *N. luzonicus* the alate of *N. meridianus* can hardly be distinguished, but the brown color of the alate seems characteristic as also the orange tinge of the soldier's head, the greater width of head, the much lighter color of the tergites, and other features. More complete knowledge may ultimately show these species and others of the *matangensis* group to be true (geographic) subspecies of a single or a very few species.

Distribution and biology.—Of the six vials of this species in the collection one was from Jolo. The others were from Palawan, two from Sir J. Brooke Point and three from Thumb Peak near Iwahig. All were collected by Taylor, who notes that the Jolo collection (313) was from a paper nest in wood. One collection from Sir J. Brooke Point was from runways on a dead log; one of the Thumb Peak collections taken at 2,000 feet was from a paper nest and the other two were from rotten wood.

14. NASUTITERMES OSHIMAI sp. nov. Text fig. 15.

Alate.—Unknown.

Soldier.—Head pale orange-brown, lighter behind; rostrum centrally darker, tergites barely pigmented.

Head and rostrum shaped as in fig. 15, *a* and *b*, very similar to, but smaller than, *N. panayensis;* rostrum slightly thicker at base than in the latter species. Mandible as in fig. 15, *b*.

Antennæ pale yellow, of twelve segments, slightly less than length of head with rostrum.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes oshimai sp. nov., from the type collection, No. 1509, Laguna.

Length of head and rostrum	1.47
Length of head without rostrum	0.90
Length of rostrum	0.57
Head production	0.24
Height of head	0.60
Width of head	0.90
Length of fore tibia	0.78
Head index	1.00
Head-rostrum index	0.63
Head production index	0.27
Leg elongation index	0.87

Systematic position and distribution.—This species is represented by two collections, from Paete, Laguna Province, Luzon, each containing a single soldier, which were collected by McGregor. These were sent to McGregor and the senior author by Doctor Oshima as autotypes of *N. gracilis*. They clearly disagree with Oshima's description and belong with the brown-headed *matangensis* group of species, being nearest to *N. panayensis* Oshima from which they differ distinctly in their much smaller size, much shorter hind tibia, and the lack of pigmentation of the abdominal tergites.

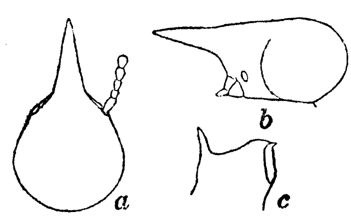


FIG. 15. *Nasutitermes oshimai* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

This is the only nasute of this group known from Luzon, and there remains the possibility that it is actually from a southern island and was misplaced in handling. The two collections on hand are probably from the same colony. We take pleasure in naming the species for Dr. Masamitsu Oshima, pioneer student of Philippine termites.

15. NASUTITERMES CHAPMANI sp. nov. Text fig. 16.

Dealate (*fig. 16, a*).—Head brown, postclypeus and labrum yellowish brown; antennæ light brownish yellow; pronotum yellowish brown; mesonotum centrally brownish ivory white; tergites chestnut-brown; sternites pale yellow, laterally brownish. Head shaped as in fig. 16, *a;* width through eyes 1.65 mm.

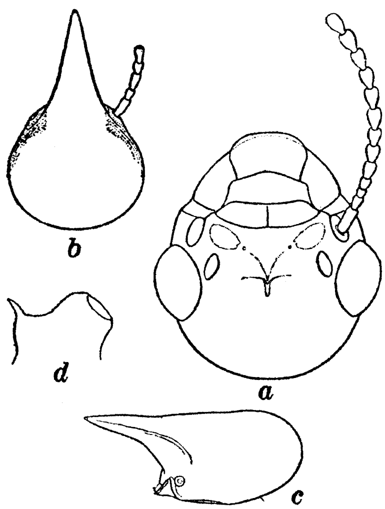


FIG. 16. *Nasutitermes chapmani* sp. nov.; *a*, head of alate in dorsal view; *b*, head of soldier in dorsal view; *c*, head of soldier in lateral view; *d*, left mandible of soldier.

Fontanel (fig. 16, *a*) prominent, narrowly triangular, flaring anteriorly; about three-fourths as long as short diameter of ocellus.

Ocellus elliptical, long diameter about one-third the long diameter of eye; separated from eye by about one-third the diameter of ocellus.

Eye separated from lower margin of head by about one-sixth its own diameter, from upper margin of head by about one-fourth its own diameter, and from posterior margin by about seven-tenths its own diameter.

Measurements in millimeters of a dealate of Nasutitermes chapmani sp. nov., from collection 570, from Negros.

Length of body with head	7.27
Length of head	1.78
Length of head capsule	1.31
Width of head capsule	1.28
Width of head with eyes	1.65
Length of pronotum	0.79
Width of pronotum	1.49
Long diameter of eye	0.634
Short diameter of eye	0.518
Long diameter of ocellus	0.182
Short diameter of ocellus	0.140
Distance of ocellus from eye	0.040

Soldier (*fig. 16, b to d*).—Head orange-brown; rostrum darker at base and tip; tergites hardly pigmented.

Head and rostrum shaped as in fig. 16, *b* and *c*. Head low, only slightly elevated behind; dorsal profile nearly flat, only

faintly sinuous; rostrum very thick near base, tapering gradually to a sharp tip.

Antennæ of twelve segments, about two-thirds as long as head with rostrum; segment III longer than II and IV, which are subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes chapmani sp. nov., from collection 945, from Negros.

Length of head with rostrum	1.53
Length of head without rostrum	0.96
Length of rostrum	0.57
Head production	0.30
Height of head	0.64
Width of head	0.99
Length of fore tibia	0.78
Head index	1.03
Head-rostrum index	0.59
Head production index	0.31
Leg elongation index	0.81

Systematic position.—*Nasutitermes chapmani* sp. nov. is most closely related to *N. panayensis* (Oshima) and *N. meridianus* sp. nov. The alate is larger than that of either species and has relatively larger eyes than has either of these species. In color it is much like *N. meridianus,* but the large eye distinguishes it, as also the smaller ocellus, much more sparsely haired head, and larger, differently shaped pronotum, as well as the orange color of antennæ, thorax, etc., in *N. meridianus.*

The soldier differs from *N. panayensis* in its smaller body with hardly chitinized sclerites, the lighter color of the head, and the narrower head with thick-based rostrum. From *N. meridianus* the soldier differs in the same way as from *N. panayensis* and in addition in the absence of the characteristic orange color of head, antennæ, sclerites, etc.

Distribution and biology.—Two of the three collections were taken on the Cuernos de Negros, above Dumaguete, one by Dr. A. W. Herre, at that time of the Philippine Bureau of Science; the other taken by the senior author and Dr. James Chapman, of Silliman Institute, for whom the species is named, was from a young colony in the dead wood of a limb stub 7 feet above the ground. The third was taken by Dr. E. H. Taylor from wood on the water reservation back of Zamboanga.

16. NASUTITERMES PARVUS sp. nov. Text fig. 17.

Alate.—Unknown.

Soldier (*fig. 17, a to c*).—Head gray smoky yellow-brown; rostrum light brown; tergites very faintly pigmented. Very small, less than 3 mm long.

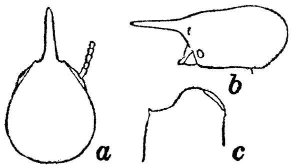


FIG. 17. *Nasutitermes parvus* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

Head and rostrum shaped as in fig. 17, *a* and *b*, rostral hump prominent; head anteriorly depressed; rostrum narrowed near base with conspicuous sharp-tipped hump on front of head on either side of base of rostrum. Head covered with a coat of slender, curved, whitish hairs and a very few, stiff, spinelike hairs. Mandible with a vestigial free portion.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes parvus sp. nov., from the type collection, No. 314, from Jolo.

Length of head and rostrum	1.20
Length of head without rostrum	0.76
Length of rostrum	0.44
Head production	0.27
Height of head	0.48
Width of head	0.69
Length of fore tibia	0.54
Head index	0.91
Head-rostrum index	0.57
Head production index	0.35
Leg elongation index	0.71

Remarks.—This very characteristic little species is represented by a single collection, taken by Taylor on Jolo Island. Its small size, its peculiar head shape, the conspicuous projections on the head on either side of the rostrum, the strongly narrowed base of the rostrum, and the vestigial nature of the free portion of the mandible, as also the 11-segmented antennæ, seem to distinguish it readily from any other Philippine species, as well as from any other species of the genus known to us.

17. NASUTITERMES ROTUNDUS sp. nov. Text fig. 18.

Alate.—Unknown.

Soldier (*fig. 18, a to c*).—Head dull yellow; rostrum pale reddish; tergites pale yellow, very lightly chitinized.

Head and rostrum shaped as in fig. 18, *a* and *b*, dorsal profile concave despite a slight rostral hump; head depressed in front;

rostrum distally slightly uplifted. Head with a coat of slender whitish hairs and a few, scattered, spinelike hairs. Left mandible as in fig. 18, *c*.

Antennæ of twelve segments, about five-sevenths as long as head with rostrum, segments II and III subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes rotundus sp. nov., from the type collection, No. 1154, from Cotabato, Mindanao.

Length of head and rostrum	1.62
Length of head without rostrum	0.96
Length of rostrum	0.66
Head production	0.24
Height of head	0.66
Width of head	1.02
Length of fore tibia	0.72
Head index	1.06
Head-rostrum index	0.69
Head production index	0.25
Leg elongation index	0.75

Remarks.—The single collection of this very distinct species was taken by Taylor on the Cotabato coast, Mindanao. Nothing is known of its biology.

18. NASUTITERMES BALINTAUACENSIS (Oshima). Text fig. 19.

Eutermes (*Eutermes*) *balintauacensis* OSHIMA, 1917, 1920.

Alate.—Unknown.

Soldier (*fig. 19, a to c*).—Head smoky yellow; rostrum darker, light yellow-brown; tergites pale yellow, very lightly chitinized.

Head and rostrum shaped as in fig. 19, *a* and *b*, rostrum long and slender, rostral hump long, conspicuous; constriction some distance behind antennæ. Mandible (fig. 19, *c*) with long apical portion. Head covered with very minute whitish hairs and scattered spinelike hairs of two sizes.

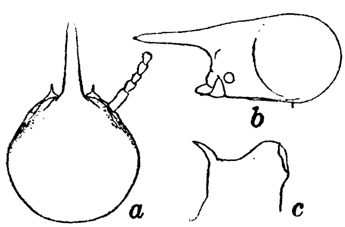


FIG. 18. *Nasutitermes rotundus* sp. nov., soldier; *a*, head in dorsal view; *b*, head lateral view, *c*, left mandible.

Antennæ of twelve segments, nearly three-fourths as long as head with rostrum; segments II and III shortest, subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes balintauacensis (Oshima), from collection 117, from Taytay, Rizal Province, Luzon.

Length of head and rostrum	1.32
Length of head without rostrum	0.78
Length of rostrum	0.54
Head production	0.27
Height of head	0.53
Width of head	0.78
Length of fore tibia	0.66
Head index	1.00
Head-rostrum index	0.69
Head production index	0.35
Leg elongation index	0.85

Variation.—Despite some variation in head width and color, the soldiers of the eight collections at hand are very similar. The head index ranges from 0.93 to 1.00 and the head-rostrum index from 0.60 to 0.70.

Systematic position.—This species can be readily distinguished from other known Philippine species with awl-shaped rostra by the very weak constriction of the head (fig. 19, *a*) and the long free portion of the mandible (fig. 19, *c*). It approaches the species of the *constrictoides* group, but differs in the very slight nature of the constriction.

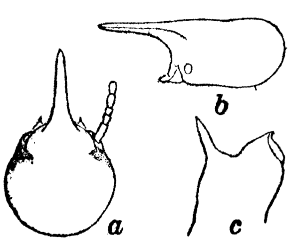


FIG. 19. *Nasutitermes balintauacensis* (Oshima), soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

Distribution and biology.—The eight collections are all from central Luzon: Rizal, Laguna, and Bataan Provinces. Three are from Mount Mariveles at an altitude of 1,000 to 5,000 feet, one from Mount Maquiling (2,000 feet), one from Limay, Bataan, and one from Paete, Laguna (autotype). Oshima described the species from material from Balintawac, Rizal.

It has been encountered most commonly on mountain slopes, which indicates its association with the original forest. Nothing is known of its biology save that one colony was found by the senior author, attacking the roots of a *Hevea* rubber tree in the grounds of the School of Forestry, near Los Baños, Laguna. The weakened tree was blown down, thus exposing the termites.

19. NASUTITERMES TAYLORI sp. nov. Text fig. 20.

Alate (fig. 20, a).—Dorsal surface dark smoky brown, ventral surface light brown; head dark brown, postclypeus and labrum

pale brown; antennæ brown; pronotum dark brown; mesonotum deep ivory brown; tergites very dark smoky brown; sternites light brown, centrally pale; wing membrane dusky brown; a transparent strip extending from wing scale to posterior third of wing, radius sector deep brown throughout; costal margin brown, subcostal stripe slightly narrower and lighter than radius sector.

Head small, width through eyes 1.32 mm; shaped as in fig. 20, *a*.

Fontanel gleaming white, conspicuous, narrowly lenticular, at least as long as ocellus. Ocellus elliptical, long diameter not quite twice short diameter; long diameter about half diameter of eye; separated from eye by about long diameter of ocellus.

Eye small, projecting; separated from lower margin of head by about one-third its own diameter, from upper margin of head by more than one-half its diameter, and from posterior margin by more than its own diameter.

Measurements in millimeters of a typical alate of Nasutitermes taylori sp. nov., from the type collection, No. 1158, from Cotabato, Mindanao.

Length over all	13.06
Length of forewing	11.04
Width of forewing	2.94
Length of head	1.51
Length of head capsule	1.05
Width of head capsule	1.08
Width of head with eyes	1.33
Length of pronotum	0.69
Width of pronotum	1.12
Diameter of eye	0.36
Long diameter of ocellus	0.14
Short diameter of ocellus	0.12
Distance of ocellus from eye	0.09

Soldier (*fig. 20, b to f*).—Head light smoky yellow-brown, lighter behind; rostrum red, dark at base; tergites brown, heavily chitinized.

Head and rostrum shaped as in fig. 20, *b* to *e;* rostrum long, rostral hump conspicuous; constriction distinct; a sparse growth of slender whitish hairs on head.

Antennæ of twelve or thirteen segments, when thirteen segments, II and IV shortest, III twice as long as IV.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes taylori sp. nov., from collection 1158, from Cotabato, Mindanao.

Length of head with rostrum	1.62
Length of head without rostrum	0.96

Length of rostrum	0.66
Head production	0.33
Height of head	0.62
Width of head	0.91
Length of fore tibia	0.84
Head index	0.95
Head-rostrum index	0.69
Head production index	0.34
Leg elongation index	0.88

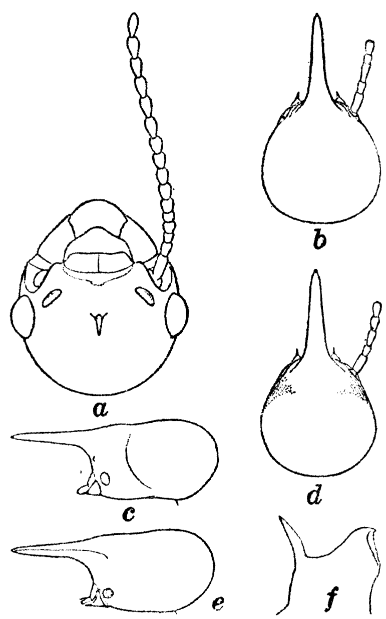


FIG. 20. *Nasutitermes taylori* sp. nov.: *a*, head of alate in dorsal view; *b* and *d*, heads of soldiers in dorsal view; *c* and *e*, heads of soldiers in lateral view; *f*, left mandible of soldier.

Remarks.—The two collections of this species were taken by Taylor, one on Tatayan Island, off the Cotabato coast of Mindanao, and the other near Caldera, Cotabato. One taken in early April contained numerous fully pigmented alates.

Superficially, the soldiers of this species are close to those of *N. castaneus* (Oshima), but differ in having larger heads and relatively shorter rostra, the rostral index being less than 0.70, while that of *N. castaneus* is more than 0.75. The pronotum also is less heavily chitinized in *N. taylori*. Differences will be seen in the mandibles (figs. 20, *f*, and 21, *c*), but these may lose significance when the varietal range is better known.

20. NASUTITERMES CASTANEUS (Oshima). Text fig. 21.

Eutermes (*Eutermes*) *castaneus* OSHIMA, 1920.

Alate.—Unknown.

Soldier (*fig. 21, a to c*).—Head smoky brownish yellow; rostrum slightly darker at base, reddish distally; tergites brownish yellow, well pigmented.

Head and rostrum shaped as in fig. 21, *a* and *b*. A few slender whitish hairs on head; rostral hump prominent and long, a sharply depressed saddle at its base; rostrum long and slender.

Antennæ of twelve or thirteen segments; when thirteen segments, II and IV shortest, III twice as long as IV.

Measurements in millimeters, and indices, of two paratype soldiers of Nasutitermes castaneus (Oshima), from collection 1501, from Culasi, Panay.

Length of head and rostrum	1.56	1.50
Length of head without rostrum	0.88	0.86
Length of rostrum	0.68	0.66
Head production	0.27	0.27
Height of head	0.63	0.60
Width of head	0.93	0.83
Length of fore tibia	0.81	0.78
Head index	1.05	0.97
Head-rostrum index	0.77	0.77
Head production index	0.31	0.31
Leg elongation index	0.92	0.94

Remarks.—The autotype collection available through the kindness of Doctor Oshima is from Culasi, Panay, and was collected by McGregor. The species may be distinguished from *N. taylori* sp. nov., described above, which it approaches in many ways, chiefly by the relatively longer rostrum and shorter head of the soldier in *N. castaneus.*

21. NASUTITERMES MCGREGORI (Oshima).

Eutermes (Ceylonitermes) mcgregori OSHIMA, 1916, p. 36 (soldier, not imago), pl. 1, fig. 10, nec *Eutermes (Ceylonitermes) mcgregori* Oshima, 1920 (see under *N. panayensis* Oshima).

Alate.—Unknown. See discussion below.

Soldier.—(Derived from Oshima's description and figure.) Head pale brown, rostrum darker; tergites pale yellowish white, lightly chitinized.

Head elongated, pear-shaped, with conspicuous constriction; dorsal profile nearly concave; rostrum slender, "conical," relatively long; head-rostrum index under 0.73 (based on Oshima's measurements).

Antennæ of twelve segments; II to IV subequal.

Measurements in millimeters of a soldier of Nasutitermes mcgregori (Oshima).

Length of body	4.00
Length of head with rostrum	1.56
Length of head	0.90
Width of head	0.93
Width of pronotum	0.46

Worker.—"Basal portion of clypeus *shorter* than half the width."

Remarks.—This species was described by Oshima in 1916 on the basis of material collected by McGregor in Laguna Province,

Luzon. He ascribes to it a dealate, which he does not figure but of which he says, "pronotum considerably broader than head" and "anterior wing stumps covering anterior half of the posterior," characters which indicate that he was dealing with a species of the Rhinotermitidæ, probably *Schedorhinotermes* sp.

The soldier that he illustrates belongs to the *constrictoides* group but differs strikingly in the long rostrum.

In 1920 he reported a collection taken by McGregor in Antique Province, Panay, as belonging to this species. Examination of individuals from this colony sent to the Bureau of Science and to the senior author as autotypes of *N. mcgregori* shows them to belong to his *N. panayensis.*

Oshima placed this species in the subgenus *Ceylonitermes.* It must be admitted that there is a similarity in shape of head between the soldier of *N. mcgregori* and that of *Eutermes* (*Ceylonitermes*) *escherichi* Holmgren (1911). The soldier of *N. mcgregori* lacks the elongated antennæ and legs, which characterize the soldier in *Ceylonitermes;* and, of more importance, Oshima in his description of the worker states, "basal portion of the clypeus shorter than half the width," while Holmgren places *Ceylonitermes* in the group of subgenera the workers of which have a postclypeus about as long as half its width ("Clypeobasole der Arbeiter stets etwa so lang wie seine halbe Breite"). In the description of *E.* (*C.*) *escherichi* he says: "Clypeus gross, aufgetrieben, so lang wie seine halbe Breite." We have, therefore, placed the species in the subgenus *Nasutitermes* sen. str. (= *Eutermes* sen. str. Holmgren).

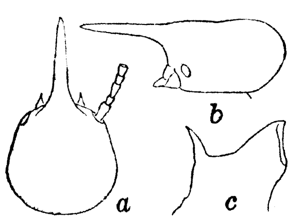


FIG. 21. *Nasutitermes castaneus* (Oshima), soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

22. NASUTITERMES CONSTRICTICEPS sp. nov. Text fig. 22.

Alate.—Unknown.

Soldier (*fig. 22, a to c*).—Head smoky brown; rostrum dark, distally pale reddish; tergites brown, well chitinized.

Head and rostrum shaped as in fig. 22, *a* and *b*. Head expanded and greatly produced behind; head constricted some distance behind the antennæ; rostrum relatively short, dorsal profile in lateral view concave, rostral hump wanting or only faintly suggested.

Mandibles (fig. 22, *c*) with straight or concave sides and a long, sharp, free portion in line with the side.

Antennæ of thirteen segments, somewhat elongated, slightly longer than length of head with rostrum; segments II and IV shortest, subequal; segment III elongated, at least as long as elongated distal segments.

Measurements in millimeters, and indices, of three soldiers of Nasutitermes constricticeps sp. nov., from the type collection, No. 1159, from Zamboanga, Mindanao.

	Largest.	Smallest.	Average.
Length of head and rostrum	1.68	1.56	1.59
Length of head without rostrum	1.20	1.05	1.11
Length of rostrum	0.48	0.51	0.48
Head production	0.54	0.42	0.48
Height of head	0.72	0.63	0.62
Width of head	1.02	0.87	0.90
Length of fore tibia	0.84	0.75	0.84
Head index	0.85	0.83	0.81
Head-rostrum index	0.40	0.49	0.43
Head production index	0.45	0.40	0.43
Leg elongation index	0.70	0.72	0.76

Remarks.—This very distinct species is based on a single collection taken by Taylor in the Caldera Bay Mountains, Zamboanga Province, Mindanao. Nothing is known of its biology.

The dark, very markedly constricted head (fig. 22, *a*), swollen behind, and the dark, strongly chitinized tergites serve to distinguish this species from *N. busuangæ* sp. nov. and *N. brevicornis* sp. nov.

23. NASUTITERMES BUSUANGÆ sp. nov. Text fig. 23.

Alate.—Unknown.

Soldier (fig. 23, a to c).—Head orange-yellow; rostrum reddish orange; tergites dull yellow, weakly chitinized.

Head and rostrum shaped as in fig. 23, *a* and *b;* dorsal profile deeply concave; rostrum somewhat uplifted; constriction not so deep as in *N. constricticeps;* anteroventral corners flaring (fig. 23, *a*). Mandible (fig. 23, *c*) broad, with oblique sides; free apical portion spinelike, much shorter than in *N. brevicornis* sp. nov. and much longer than in *Subulitermes mariveles* sp. nov.

Antennæ of thirteen segments, somewhat elongated, about six-fifths as long as head with rostrum; segment II shortest, III longest, IV and V subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes busuangæ sp. nov., from the type collection, No. 1215, from Busuanga Island.

Length of head and rostrum	1.52
Length of head without rostrum	1.04
Length of rostrum	0.48
Head production	0.32
Height of head	0.57
Width of head	0.87
Length of fore tibia	0.86
Head index	0.84
Head-rostrum index	0.46
Head production index	0.31
Leg elongation index	0.83

Remarks.—The single collection on which this species is based was taken by Taylor under coconut débris at Coron on Busuanga Island, of the Calamianes group, between Mindoro and the northern end of Palawan. Nothing is known of its biology.

This species is distinguished from nearly related species by the widely flaring anteroventral corners of the head capsule (fig. 23, *a*), the oblique sides of its mandible (fig. 23, *c*), and other characters.

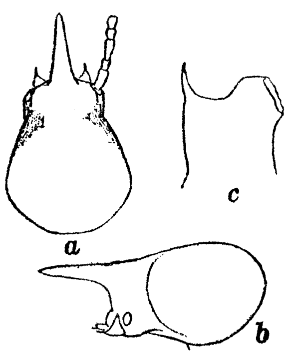


FIG. 22. *Nasutitermes constricticeps* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

24. NASUTITERMES BREVICORNIS sp. nov. Text fig. 24.

Alate.—Unknown.

Soldier (fig. 24, a to e).—Head and rostrum orange-brown; tergites light smoky brown, well chitinized.

Head and rostrum shaped as in fig. 24, *a* to *d;* head pear-shaped, strongly narrowed in front, anteroventral corners flaring; head elevated and greatly produced behind, depressed in front; rostrum short, uplifted; dorsal profile generally concave, but sinuous due to the low rostral hump. Mandible (fig. 24, *e*) with straight lateral side and usually long free portion.

Antennæ of thirteen segments, somewhat elongated, five-fourths as long as head with rostrum; segment III longest, II and IV smallest, subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes brevicornis sp. nov., from the type collection, No. 1167, from Cotabato, Mindanao.

Length of head and rostrum	1.44
Length of head without rostrum	0.98
Length of rostrum	0.46
Head production	0.39
Height of head	0.63
Width of head	0.90
Length of fore tibia	0.84
Head index	0.92
Head-rostrum index	0.46
Head production index	0.40
Leg elongation index	0.85

Remarks.—Two collections of this species were taken by Taylor in Cotabato Province, Mindanao. Nothing is known of its biology.

The relatively very short rostrum, giving a head index of less than 0.50, and the very long apical portion of the mandible (fig. 24, *e*) distinguish this species. Variation in width of head is brought out in fig. 24, *a* and *b*, and in shape of head in lateral view in fig. 24, *c* and *d*.

Genus SUBULITERMES Holmgren

25. SUBULITERMES MARIVELES sp. nov. Text fig. 25.

Alate (fig. 25, a).—Head very dark black-brown, postclypeus light brown, labrum very pale; antennæ brown; pronotum rusty brown; mesonotum centrally ivory brown; tergites dark brown; sternites pale yellow-brown, laterally smoky brown; wing membrane pale brown, veins brown, radius sector continuous with dark brown stripe of same width, subcostal stripe brownish yellow, about as wide as radius sector, separated from brown stripe by an irregular clear line; a narrow area between radius sector and costa.

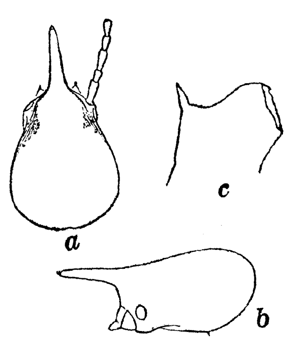


FIG. 23. *Nasutitermes busuangæ* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

Head small; width through eyes 1.32 mm; head shaped as in fig. 25, *a*.

Fontanel (fig. 25, *a*) broad, abruptly flaring anteriorly, terminating in two sharp lateral points; nearly twice as long as ocellus.

Ocellus circular, diameter about one-third diameter of eye; separated from eye by about one and one-half times diameter of ocellus.

Eye small, separated from lower margin of head by about one-fourth its diameter, from upper margin of head by more than one-half its diameter, and from posterior margin by more than its own diameter.

Antennæ of fourteen or fifteen segments; III smallest, very short and narrow; II and IV subequal; distal segments somewhat elongated.

Pronotum longer than half its breadth, anterolateral corners broadly rounded; sides converging posteriorly, rounding slightly into nearly straight, medially slightly concave, posterior border.

Measurements in millimeters of a typical alate of Subulitermes mariveles sp. nov., from the type collection, No. 684, from Mount Mariveles, Bataan Province, Luzon.

Length over all	14.72
Length of forewing	13.20
Width of forewing	2.86
Length of head	1.54
Length of head capsule	1.00
Width of head capsule	0.97
Width of head with eyes	1.25
Length of pronotum	0.71
Width of pronotum	1.07
Diameter of eye	0.34
Long diameter of ocellus	0.15
Short diameter of ocellus	0.11
Distance of ocellus from eye	0.11

Soldier (*fig. 25, b to d*).—Head light smoky brown; rostrum dark smoky brown, with faintly reddish tip; tergites very pale yellow-brown, very slightly chitinized.

Head and rostrum shaped as in fig. 25, *b* and *c*, dorsal profile sinuous, rostral hump distinct, low and long, set off by grooves from somewhat swollen posterior portion of head and anteriorly from somewhat straight ventral margin of the head. Head with sparse growth of short whitish hairs.

Mandible (fig. 25, *d*) long and narrow, with very small free portion and anteriorly projecting molar region.

Antennæ of twelve segments, not elongated, slightly shorter than length of head with rostrum; segments II and III shortest, subequal.

Measurements in millimeters, and indices, of a typical soldier of Subulitermes mariveles sp. nov., from the type collection, No. 684, from Mount Mariveles, Bataan Province, Luzon.

Length of head and rostrum	1.45
Length of head without rostrum	0.94
Length of rostrum	0.51
Head production	0.30
Height of head	0.57
Width of head	0.81
Length of tibia	0.75
Head index	0.86
Head-rostrum index	0.54
Head production index	0.32
Leg elongation index	0.80

Remarks.—The three collections are all from the slopes of Mount Mariveles at 1,000 and 1,500 feet altitude, collected by McGregor and Light, June 21, 1921, at which time mature alates were found in one colony. Nothing is known of the biology.

The soldier of this species is easily distinguished from the other Philippine species with long pear-shaped heads, short rostra, and a more or less distinct constriction behind the antennæ by the inconspicuous nature of the constriction, the lack of elongation of the antennæ, the short antennal segment III, and the vestigial nature of the apical portion of the mandible.

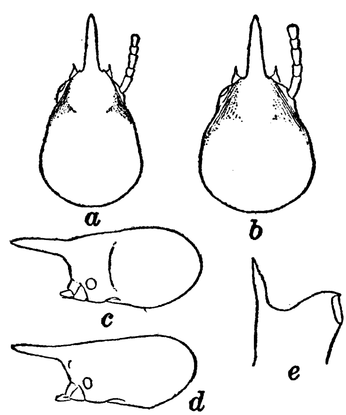


FIG. 24. *Nasutitermes brevicornis* sp. nov., soldiers; *a* and *b*, heads in dorsal view; *c* and *d*, heads in lateral view; *e*, left mandible.

The vestigial nature of the mandibles, together with the fact that the postclypeus of the worker is about one-half as long as wide, seems to necessitate placing this species in the genus *Subulitermes* pending a more careful investigation of the groups of nasute termites.

26. SUBULITERMES MINDANENSIS sp. nov. Text fig. 26.

Alate (*fig. 26, a*).—Generally dark brown; head very dark brown, postclypeus and labrum pale yellow-brown; antennæ brown; pronotum rusty brown; mesonotum ivory brown; tergites dark brown; sternites brown, centrally pale; wing membrane dusky brown, radius sector deep brown, costal margin

brown, subcostal stripe barely visible; cubitus and median separated by a narrow clear area extending from wing scale to central point of wing.

Head small; width through eyes 1.02 mm; head shaped as in fig. 26, *a*.

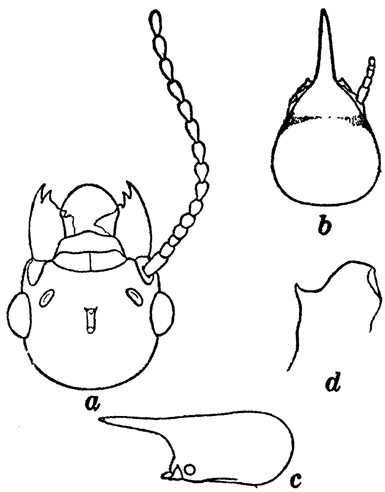


FIG. 25. *Subulitermes mariveles* sp. nov.; *a*, head of alate in dorsal view; *b*, head of soldier in dorsal view; *c*, head of soldier in lateral view; *d*, left mandible of soldier.

Fontanel narrow, club-shaped, widest posteriorly; about two-thirds as long as ocellus.

Ocellus nearly circular, slightly less than one-third diameter of eye; separated from eye by diameter of ocellus or somewhat more.

Eye small, separated from the lower margin of head by about one-fourth its own diameter, from upper margin of head by about one-third its own diameter, and from posterior margin by about its own diameter.

Antennæ of thirteen segments, III typically shortest.

Pronotum long, sides converging strongly posteriorly to curve into strongly bilobed posterior margin.

Measurements in millimeters of a typical alate of Subulitermes mindanensis sp. nov., from the type collection, No. 1144, from Cotabato, Mindanao.

Length over all	11.03
Length of forewing	9.62
Width of forewing	2.02
Length of head	1.13
Length of head capsule	0.82
Width of head capsule	0.87
Width of head with eyes	1.04
Length of pronotum	0.49
Width of pronotum	0.84
Diameter of eye	0.285
Long diameter of ocellus	0.10
Short diameter of ocellus	0.08
Distance of ocellus from eye	0.08

Soldier (*fig. 26, b to d*).—Head light smoky yellow; rostrum dark (reddish) over entire length; tergites pale yellow, very slightly chitinized.

Head and rostrum shaped as in fig. 26, *b* and *c*, head broad posteriorly, converging anteriorly, without lateral constriction; profile of head convex due to anterior depression and weak rostral hump; rostrum short, awl-shaped; an inconspicuous hump on either side of head near base of rostrum; mandible (fig. 26, *d*) extremely reduced, apical portion obsolete and that side of mandible reduced.

Antennæ of eleven segments, about two-thirds as long as head with rostrum.

Measurements in millimeters, and indices, of a soldier of Subulitermes mindanensis sp. nov., from collection 1144, Cotabato Province, Mindanao.

Length of head and rostrum	1.41
Length of head without rostrum	0.87
Length of rostrum	0.54
Head production	0.24
Height of head	0.59
Width of head	0.87
Length of fore tibia	0.72
Head depression	0.12
Head index	1.00
Head-rostrum index	0.62
Head production index	0.28
Leg elongation index	0.83
Head height index	0.68
Head depression index	0.20

Remarks.—There are three collections of this species, all made by Taylor at different localities in Cotabato Province, Mindanao, in April, 1923. Two of these contain numerous alates. Nothing is known of their biology.

The species is readily distinguished from all other species known to us by the vestigial mandible of the soldier, which not only lacks a free portion, but which has the anterolateral region of the mandible reduced. This, with the long swollen postclypeus of the worker, places the species in *Subulitermes*. Without dissection the soldier somewhat resembles that of *N. balintauacensis* (Oshima), from which it may be distinguished by the depressed head with convex lateral profile as well as by the shorter rostrum.

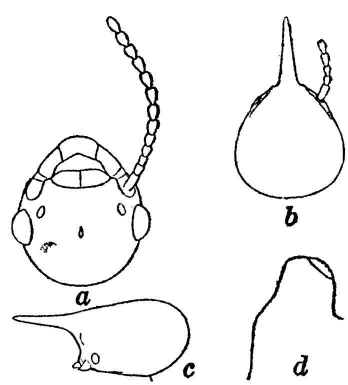


FIG. 26. *Subulitermes mindanensis* sp. nov.; *a*, head of alate in dorsal view; *b*, head of soldier in dorsal view; *c*, head of soldier in lateral view; *d*, left mandible of soldier.

ILLUSTRATIONS

[All figures are magnified eighteen times save those of the mandibles, which are magnified eighty times.]

FIG. 1. *Nasutitermes taylori* sp. nov., outline drawings of head of alate and of soldier, to illustrate the dimensions used; *A*, head of soldier in lateral view; *B*, head of soldier in dorsal view; *C*, head of alate in dorsal view; *a*, junction of head and neck; *bc*, length of head with rostrum; *de*, length of rostrum; *fg*, width of head; *hi*, height of head; *kl*, head production; *mn*, length of head capsule of alate; *on*, length of head over all; *pq*, width of head of alate through the eyes; *rs*, width of head of alate behind the eyes.

2. *Lacessititermes palawanensis* Light; *a*, head and pronotum of alate in dorsal view; *b* and *c*, head of soldier in dorsal and lateral views, respectively.

3. *Lacessititermes holmgreni* sp. nov.; *a*, head of alate in dorsal view; *b* and *c*, head of soldier in dorsal and lateral views, respectively.

4. *Hospitalitermes luzonensis* Oshima; *a*, head and pronotum of alate in dorsal view; *b* and *c*, head of soldier in dorsal and lateral views, respectively.

5. *Grallatotermes admirabilus* Light, head of soldier; *a*, dorsal view; *b*, lateral view.

6. *Grallatotermes splendidus* sp. nov., head of soldier; *a*, dorsal view; *b*, lateral view.

7. *Nasutitermes atripennis* (Haviland), head of soldier; *a*, dorsal view; *b*, lateral view.

8. *Nasutitermes gracilis* (Oshima); *a*, head of alate from Ilocos Norte in dorsal view; *b* to *d*, heads of soldiers in dorsal view to show variation (*b* from Palawan, *c* from Rizal, *d* from Ilocos Norte from same colony as *a*); *e* to *i*, heads of soldiers in lateral view to show variation (*e* from Mount Mariveles, Bataan; *f* from Panay, *g* from Mindanao, *h* from Ilocos Norte, *i* from Rizal); *j* and *k*, left mandibles of soldiers (*j* from Cotabato, the typical form; *k* from Panay, an extreme variant, probably abnormal).

9. *Nasutitermes mollis* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

10. *Nasutitermes luzonicus* (Oshima); *a*, head of alate in dorsal view; *b* to *g*, heads of soldiers in dorsal view to show variation in size and proportions (*e* to *g*, individuals from the same colony, No. 113, from Rizal; *g* is probably abnormal); *h* to *j*, heads of soldiers in lateral view to demonstrate variations in dorsal profile and size of rostrum; *k* to *m*, left mandibles of soldiers to illustrate variations.

FIG. 11. *Nasutitermes simulans* sp. nov.; *a* and *b*, heads of two soldiers from the same colony, in dorsal view, to show range of variation; *c* and *d*, heads of two soldiers from the same colony, in lateral view, to show range of variation; *e* and *f*, left mandibles of soldiers.

12. *Nasutitermes latus* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c* and *d*, left mandibles.

13. *Nasutitermes panayensis* (Oshima); *a*, head of alate in dorsal view; *b* to *d*, heads of soldiers in dorsal view (*b* from an autotype from Culasi, Panay; *c* from a specimen from Tibiao, Panay, labeled by Oshima "*Ceylonitermes Mcgregori*" from which, of course, it differs very widely; *d* from an abnormal soldier with thick rostrum, taken in Negros); *e*, head of typical soldier in lateral view; *f*, head of abnormal soldier (same as *d*) in lateral view; *g* to *j*, left mandibles of soldiers (*j* from abnormal soldier *d* and *f*).

14. *Nasutitermes meridianus* sp. nov.; *a*, head of alate in dorsal view; *b* to *d*, heads of soldiers in dorsal view, to show range in size and proportions, all from Palawan; *e*, head of soldier in lateral view; *f* to *i*, left mandibles of soldiers to show variation.

15. *Nasutitermes oshimai* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

16. *Nasutitermes chapmani* sp. nov.; *a*, head of alate in dorsal view; *b*, head of soldier in dorsal view; *c*, head of soldier in lateral view; *d*, left mandible of soldier.

17. *Nasutitermes parvus* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

18. *Nasutitermes rotundus* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

19. *Nasutitermes balintauacensis* (Oshima), soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

20. *Nasutitermes taylori* sp. nov.; *a*, head of alate in dorsal view; *b* and *d*, heads of soldiers in dorsal view; *c* and *e*, heads of soldiers in lateral view; *f*, left mandible of soldier.

21. *Nasutitermes castaneus* (Oshima), soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

22. *Nasutitermes constricticeps* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

23. *Nasutitermes busuangæ* sp. nov., soldier; *a*, head in dorsal view; *b*, head in lateral view; *c*, left mandible.

24. *Nasutitermes brevicornis* sp. nov., soldiers; *a* and *b*, heads in dorsal view; *c* and *d*, heads in lateral view; *e*, left mandible.

25. *Subulitermes mariveles* sp. nov.; *a*, head of alate in dorsal view; *b*, head of soldier in dorsal view; *c*, head of soldier in lateral view; *d*, left mandible of soldier.

26. *Subulitermes mindanensis* sp. nov.; *a*, head of alate in dorsal view; *b*, head of soldier in dorsal view; *c*, head of soldier in lateral view; *d*, left mandible of soldier.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

MAY 1, 1936

American society for testing materials. Index to A. S. T. M. standards and tentative standards. Philadelphia, Pa., The Society, 1936. 159 pp.

HUBBARD, G. E. Eastern industrialization and its effect on the west with special reference to Great Britain and Japan. London, Oxford univ. press, 1935. xxii + 395 pp., tables. Price, $7.

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KLINEBERG, OTTO. Race differences. N. Y. and London, Harper, 1935. ix + 367 pp., tables. Price, $2.50.

MORENO, J. L. Who shall survive? A new approach to the problem of human interrelations. Washington, D. C., Nervous and mental disease publishing co., 1935. xvi + 437 pp., illus., diagrs. Price, $4.

PAULIAN, D. Tumeurs de l'encéphale; contributions a l'etude anatomoclinique des tumerus intracraniennes et du repérage ventriculaire. Paris, Masson et cie, 1935. iii + 213 pp., illus. Price, $1.25.

SCHULTZ, THEODORE W. Vanishing farm markets and our world trade. Boston, N. Y., 1935. 41 pp., diagrs. Price, $0.50.

STEPHENSON, THOMAS. Incompatibility in prescriptions and how to avoid it with a dictionary of incompatibilities. 4th ed., rev. and enl. Edinburgh, The Prescriber offices, 1935. vii + 62 pp. Price, $2.

REVIEWS

Men, Money and Molecules. By Williams Haynes. Doubleday, Doran & Co., New York, 1936. 186 pp. Price, $1.50.

This book gives a very interesting and popular account of the development of the American chemical industry.

The average person scarcely realizes the magnitude of this industry, for the value of chemicals produced annually in the United States is greater than the combined annual production of Germany, England, France, Italy, Japan, and Russia.

The United States has abundant supplies of raw materials, and there are now in operation the most complicated modern types of chemical enterprises, such as the manufacture of dyes, fixed nitrogen, medicinal compounds, and numerous other products.

The World War awakened the public to the importance of chemicals. The spread of chemical processes through most industries has brought the manufacture of chemicals from an inconspicuous and wholly auxiliary position to a pivotal place as the supplier of materials that have become prime necessities of all manufacturing.

All sorts of raw materials are likely to be appraised upon the basis of their chemical constituents as the chemicalization of industries proceeds.

This is, indeed, a very interesting and instructive little book that should be widely read. It also contains an American chemical chronology beginning with the production of wood tar and potash in Virginia in 1608.—A. P. W.

Lobar Pneumonia and Serum Therapy. By F. T. Lord and Roderick Heffron. The Commonwealth Fund, New York, 1936. 91 pp. Price, $1.

This is a handbook of well-established bacteriological and immunological principles as applied to the diagnosis and treatment of lobar pneumonia in Massachusetts. The authors' experience in the successful application of antipneumococcus serum therapy in the state since 1931 prompts them to advocate its wider use in general medical practice. For this purpose the rapid typing and early administration of the type-specific antipneumococcus serum is essential. The dosage and the technic of administration

of the serum are given in detail. As in all serotherapy, proper selection of patients suitable for serum treatment through personal inquiry and sensitivity tests is emphasized as a precaution against troublesome and possibly fatal allergic reactions.

In the authors' experience timely and proper administration of the antiserum treatment results in marked improvement within eight to twenty-four hours after the initial injection, particularly in type I. Cyanosis and dyspnœa are relieved, the temperature drops, and the patient becomes clearer mentally. The course of the acute symptoms is shortened and made milder. Bacteriæmia is prevented or, if present, is readily checked. The mortality rate is reduced from 25 to 11.1 per cent in type I infections and from 41 to 27.2 per cent in type II. The high fatality rate in bacteriæmic cases is also considerably lowered.

Since, at present, effective serum therapy in pneumonia is confined to type I and II infections (the causative agents in about 60 per cent of lobar pneumonia cases in temperate climates) this method of treatment is of little value in the Philippines, where the offending organism in 80 per cent of pneumonia patients is of the heterogenous type IV.— W. V.

Hospital Organization and Management. By M. T. MacEachern. Physicians' Record Co., Chicago, 1935. 944 pp., illus. Price, $7.50.

Although Doctor MacEachern's qualifications by training and experience in hospital organization and management are not known, after a careful perusal of his book he reveals himself to us as one possessing a rich background. For the first time we have the advantage of having for our guidance a vast array of facts on all phases of hospital organization and management thoroughly and clearly presented in a single volume. Heretofore, we have had texts covering only some phases of hospital organization and management superficially discussed and of very limited scope.

Of special interest in this book is the broad discussion of the principles of organization with the corresponding charts which should appeal not only to hospital directors, superintendents, doctors, nurses, and other types of personnel, but even to the patients and the public, because of the vividness with which they picture the proper relationship that should exist between the persons that manage the hospital and those that they are supposed to serve. This together with the chapter on hospital ethics will remove many of the mistaken conceptions of responsibility and authority held by many hospital workers.

Two special features that will be found of great help by hospital personnel or would-be hospital organizers and administrators are the lists of the needed equipment, supplies, and materials for each hospital department, and the suggested diagram of certain services. There is no gainsaying the fact that we have experienced much waste of money and effort with the consequent ineffectiveness and inefficiency in organizing and administering hospitals without guidance coming from experience based upon keen analytic investigation, such as shown in Doctor MacEachern's book.

Doctor MacEachern lays emphasis on many modern phases of hospital organization and administration heretofore untouched. His work is exhaustive, from the early history to the twentieth century hospital, and covers such topics as the need for survey, women's auxiliary, the admitting department and it psychology, and the out-patient department. The medical social service, ethics, and public education are needed innovations in a progressive hospital, which receive as yet very negligible attention in the Philippines. These departments should be considered essential and integral parts of the hospital and should receive as much attention as other parts if the hospital is to keep pace with progressive medicine and advancing civilization.—A. P. V.

Pre-Medical Care. Comp. & ed. by E. C. Buehler. Noble and Noble, New York, 1935. 360 pp. Price, $2.

The book presents an exhaustive analysis of the pros and cons of state medicine. It is a series of articles which try to justify state medicine and, at the same time, present the disadvantages of the system. In places where health insurance has been established, the result of this system is very encouraging. On the other hand, the dark side of pre-medical care, as practiced, is the pauperization of the medical profession.

The point stressed in the book is the inability of the people to pay for adequate, proficient medical service. Hence, by group practice, the results of medical researches that have been found through years of individual effort among the members of the medical profession will find practical application to suffering humanity. Against it is the fact that, with socialized medicine, the free choice of physicians is entirely eliminated. On the whole, the book is a complete, practical presentation of socialized medicine, presenting both the advantages and the disadvantages of the system and calling attention to the point that the people are becoming less and less able to spend directly for efficient

medical service, including hospitalization, dentistry, and nursing care.

The book is worth while reading, because it is not a passionate plea for one system or another. It gives the reader an opportunity to weigh the facts presented with an open mind.—A. V.

The Physiology of Domestic Animals. By H. H. Dukes. Comstock Publishing Co., Ithaca, New York, 3d rev. ed., 1935. 643 pp., illus. Price, $6.

For years there has been a great need for an up-to-date English textbook on veterinary physiology, and the appearance of Professor Dukes's book is most gratifying.

The book deals with the physiology of all domestic animals, including fowls, giving valuable data and results of the latest scientific researches and investigations. It is backed by the author's experience and observations of more than a decade as a teacher and zealous researcher. The subject matter is divided into eleven parts of forty chapters. The introductory chapter, written by Prof. E. A. Hewitt, of Iowa State College, treats of the physicochemical basis of various phenomena involved in body functions. The succeeding chapters deal with the functional characteristics of the blood and lymph, the various systems of organs and tissues, and metabolism. The last part, which gives the physiology of reproduction, has been contributed by Prof. G. W. McNutt, of Washington State Veterinary College. The discussions of the physiology of the digestive tract, the endocrine glands, and the reproductive organs are especially interesting and practical.

The book is profusely illustrated. It also abounds in citations of authorities in the field of physiology. The comprehensive lists of references at the end of each part afford the interested student a lead into a more detailed survey of the literature on a given topic. The subject matter is so arranged that for purposes of class-room instruction assignment could start with any one of the eleven parts, without danger of materially impairing the value of the text.

While the book deals in large measure with the theoretical expositions of the fundamental laws of the functions of the different tissues and organs of the animal body, much attention is also devoted to the practical or applied aspects of the subject matter dealt with. Throughout the book the author and his collaborators have expressed their thoughts clearly and concisely, making it easy for the student to grasp the facts presented. The book will be found very useful not only by the

veterinary student and practitioner for whom it has been written primarily, but also by the student of animal husbandry, animal nutrition, and comparative physiology.—A. C. G.

The World Agricultural Situation in 1933–1934. International Institute of Agriculture, Rome. 502 pp. Price, $2.50.

A periodical publication of the International Institute of Agriculture, the 500-page book presents an extensive survey of the general trends of the present economic situation in world agriculture and of the agricultural policies and conditions in different countries. Statistical tables on production, exports, imports, and index numbers of prices of various products are widely distributed in the book with their corresponding annotations and explanations.

The first part of the economic commentary deals with the universal conditions and problems in agriculture—national planning and world economy, movements of prices, notes on market conditions, and coördination of the various forms of economic activities with the aim in view of achieving economic balance and prosperity. Mention is made of the interventions undertaken by the governments of different countries in behalf of agricultural adjustment, prominent among which are the Italian Corporations Law of 1934, the Five Year Plan of Soviet Russia, and the Agricultural Adjustment Act of the Roosevelt administration. The principal commercial products of the world are discussed comparatively with the preceding years in regard to acreage, production, yield per hectare, and movement of prices represented in the form of index numbers based on the average prices of 1927.

The second part of the volume is a detailed study of the conditions and policies in thirty important agricultural countries from Australia to the United States. Under each country are two separate chapters dealing with government measures of farm relief and with the economic conditions of agriculture. Emphasis is laid on the various steps made by the government of each country on behalf of the farmer and on the fluctuations in production and prices and their effects on the general agricultural situation.—L. Ma. G.

Tumeurs de l'Encephale. Contributions á l'Etude Anatomoclinique des Tumeurs Intra-craniennes et du Repérage Ventriculaire. Par D. Paulian. Masson et Cie., Paris, 1935. 213 pp. Price, $1.25.

Approximately the first third of this monograph is devoted to an up-to-date account of brain tumors, with particular reference

to their classification, description, and diagnosis, and with a detailed description of the different technics employed in ventriculography and the interpretation of the ventriculographic pictures. The chapter on ventriculography is quite fully presented. The author adopts the classification of brain tumors most generally followed to-day—that is, one based on embryology. The remaining part of the work is devoted to a clinical and anatomo-pathologic study of the forty-six cases of brain tumors which the author had seen in his own service during the last ten years. Thirty-six of the cases were primary tumors of the glioma group, and the rest were either metastatic cancers principally, or tuberculomas of the cerebrum and cerebellum. The text is illustrated with 189 cuts, chiefly microscopic sections of the author's personal cases. Curiously enough, there were as many male as female patients. The author finds a wide variation in the symptomatology of brain tumors, and foresees a remaking of our conceptions of the physiology of the brain and of the nerve centers, not only with respect to the better-known brain areas, but with respect to its supposedly silent areas.

Unfortunately, most of the author's patients presented such an advanced condition as to preclude successful intervention in all but a small number of them. The failure of the interventions has more than convinced the author as to the great need of early diagnosis and of operating at the opportune time; that is, during l'heure chirugicale.

It would have added to the value of the monograph if the author had discussed each case as presented; also it would have facilitated identification if the illustrations were cited parenthetically in the text or labeled with the respective case numbers.

In the preface Dr. Clovis Vincent emphasizes the fact that in the diagnosis of brain tumors it is not so much a question of great knowledge of neurology as of method in examination that counts; further, that it does no good to wait long for the result of therapeutic tests in suspected cerebral gummas since these are rare; less than 2 per cent by American statistics and less than 1 per cent by French statistics.—C. R.

Infections of the Urinary Tract. By T. E. Hammond. H. K. Lewis & Co., Ltd., London, 1935. 250 pp. Price, $2.25.

This monograph, many of whose chapters have already appeared in the Clinical Journal and in the Lancet, treats only of gonorrhœa, coli infections, and staphylococcal diseases of the genito-urinary tract, but is otherwise well presented and bal-

anced. In the chapter on frequency of micturition, one is told that women pass urine less often than men, not because their bladders are larger, but because, owing to the absence of facilities, they accustom themselves to retention for long periods. In the chapter on the diagnosis of bacterial disease of the urinary tract is given much sound, common-sense advice as to how properly to secure urine specimens for examination, a simple enough thing, it would seem, but rarely attended to scrupulously. One learns with interest that in the author's practice 80 per cent of urinary infections in both sexes are due to *Bacillus coli*. Quoting Harrison, the author says that once catheterization was started for the enlarged prostrate the average duration of life was four years, death taking place from infection of the kidneys. He speaks of "marriage-bed" pyelitis, although the health of most women improves after marriage. To him it seems that natural immunity to the gonococcus undoubtedly does exist. He believes that at present gonorrhœa is treated more efficiently than before the war, but this is due to diffusion of knowledge rather than to any advance in treatment. One is rather surprised to read that many students qualified without having a case treated or without having heard a lecture. The author lays emphasis on the bearing of the constitution upon gonorrhœa, and upon that of disease upon the course of gonorrhœa. Age, he believes, does produce some variation in the lesion that is produced by the staphylococcus, and he gives illustrations in support of his contention. The chapter on staphylococcal disease is particularly illuminating.

Unusual to a book of this kind are three appendices, one of which is on the bearing of the constitution upon bacterial disease, and the others on the practice of medicine, which make very interesting and illuminating reading, particularly the latter, from the standpoint of present medical education. In the first appendix the author elaborates on the theory of hypersthenic and hyposthenic types of constitution, at the same time giving a summary account of the theories which this thing that passes as constitution or something has undergone at different periods in the history of medicine.—C. R.

Sex Habits, a Vital Factor in Well-Being. By A. Buschke and F. Jacobsohn. Tr. from the German by Eden and Cedar Paul. Emerson Books, Inc., New York, 1933. 204 pp., illus. Price, $2.50.

This is the English translation of the work originally written in German by Drs. Abraham Buschke and Friedrich Jacobsohn.

Doctor Buschke is a specialist in urology and dermatology, and he and his colleague, Doctor Jacobsohn, have distinguished themselves by their writings on sexual hygiene and venereal disease. The present work speaks of the interest both have taken in the importance of healthful sex living.

The book is one of the sanest written on the subject. Sex functions and sex problems are discussed clearly and without bias. By limiting themselves to factual knowledge alone, the authors have succeeded in amassing concise information which meets the needs of parents, ministers, legislators, jurists, social workers, and others who deal with sex problems.

The anatomical and scientific descriptions alone are enough justification for the existence of this book. These with the chapters on puberty and sex impulses will serve as clear guides to parents in handling the many problems they have to face. The discussions on sex abnormalities also will give better understanding of conditions generally vague to the public, including some medical practitioners.—U. D. M.

The American Farmer and the Export Market. By A. A. Dowell and O. B. Jenness. The University of Minnesota Press, Minneapolis, 1934. 269 pp. Price, $2.

By getting down to the facts and presenting them as they are, the authors bring together all the factors affecting the American farmers and the distribution of their products into an interpretative discussion uncolored by speculative theories and open to intelligent consideration. The book covers a range of vital subjects from the present agricultural conditions to the problems of international trade with illustrations and maps scattered here and there calculated to give the reader a more comprehensive grasp of the topics dealth with.

The opening chapters deal with the fundamental characteristics of the present American agricultural resources and the different improvements introduced in the way of increasing the output of the farm. Crop production is analyzed from the standpoint of acreage devoted to crops and in its relation to topography, climate, and other factors that affect agricultural production in different localities. Dairying and animal production are similarly treated. Thus, the reader is furnished with sufficient background for the later chapters that touch on overproduction and distribution. The trends of production, exports, population, and consumption and their interrelations are pointed out. The cityward movement of populations is discussed to

illustrate its bearing on the present agricultural conditions of the United States. With the decline of the per capita consumption of food the question arises: Is underconsumption instead of overproduction, as is now popularly believed, the real core of the problem? The authors attempt to give a broad answer by displaying the outstanding facts from every angle, without, however, pinning too much hope on increased consumption.

After discussing the effects of modern methods of agriculture on labor replacement and surplus production, the authors turn to the possibility of shifting from export to import products with the aim in view of adjusting agriculture to a basis of self-sufficiency. In this connection a suggestion has been advanced to restrict importation of coconut oils, which principally comes from the Philippines, in order to give way to domestic butter production. But then, the authors remark wittingly, to eliminate coconut oil is to eliminate oleomargarine, soap, and other oil products manufactured in the United States. Such elimination, the authors contend, would hardly be in the domestic favor. Limitation of sugar importation from the Philippines was once suggested by some Americans as a method of increasing domestic production of the product. Again, the authors believe, such action would hardly provide additional protection to domestic producers.

The next chapters are concerned with the question of the practicability of self-sufficiency in regard to agricultural production and with the position of the American farmer in the world production of wheat, corn, and cotton and the possibilities attendant thereto. In the course of the discussion of the protection of farm products, attention is turned towards the subject of governmental policies in international trade. Mention is made of the marked interest all countries have shown since the World War in trade policies, balance of trade, and international trade coöperation. The closing chapters cover the most important recent developments in economic nationalism in America, prominent among which are the Agricultural Adjustment Act and the National Recovery Act which have largely been responsible in arousing national consciousness and public opinion anent economic problems, whose manifold questions and complexities remain to be solved.—L. Ma. G.

Vanishing Farm Markets and Our World Trade. By T. W. Schultz. (World affairs pamphlets, No. 11.) World Peace Foundation, Boston and New York, 1935. 41 pp. Price, $0.50.

This book is everything that its title implies and gives a vivid picture of the gradual disappearance of the farm markets as effected by the present world trade of the United States.

The rise of the American tariff makes it difficult to sell foreign goods with a profit in the United States. By thus reducing the purchasing power of other nations, this policy limits their capacity to absorb the United States surplus farm products, which they heretofore demanded. The author believes that if this situation continues grave adjustments are necessary for American agriculture. Neither the correction of its reciprocal tariff nor the operation of the Agricultural Adjustment Act or a similar act, which renders only a temporary improvement of farm products, is sufficient to meet the problem. The author suggests a more liberal foreign-trade policy as the best solution in order to facilitate a more normal cost and price level of agricultural products. The other method is the curtailment of production, but this will involve the shifting from one crop to another, which is quite difficult to achieve. The well-presented charts enhance the usefulness of the book.—F. G. G.

Criteria of Capacity for Independence. By W. H. Ritsher. American University of Beirut Publications of the Faculty of Arts and Sciences. Social Science Series No. 8. Syrian Orphanage Press, Jerusalem, 1934. 152 pp. Price, $2.

This painstaking study deals with the movements for independence in Iraq, the Philippines, and India. It describes the criteria for the independence of the three countries, one of which (Iraq) is already independent, and another (the Philippine Islands) is in its ten-year transition period for complete independence. The fate of British India in its movement for independence is still uncertain.

Professor Ritsher discusses the standards necessary for the recognition of new states or for admission into the League of Nations, with special emphasis upon the criteria of the capacity of Iraq in fulfilling the requirements set forth by the Permanent Mandates Commission in connection with her application for membership in the League.

The author considers as the first essential requirement for independence the maintenance of a stable government supported by (*a*) an administration capable of maintaining the regular operation of essential government services; (*b*) capacity to maintain the territorial integrity and political independence; (*c*) the maintenance of public order and security throughout the whole territory; (*d*) adequate financial resources to provide

regularly for normal government requirements; (*e*) laws and a judicial organization which will afford equal and regular justice to all; and (*f*) a united public opinion supporting the demand for independent status. The existence of a clear intention to fulfill the international responsibilities and obligations, including (*a*) effective protection of minorities; (*b*) protection of the rights and properties of foreigners; (*c*) religious freedom; (*d*) obligations to assume public debts of the former administration; (*e*) the recognition of rights legally acquired under the former administration, is the second fundamental criterion, according to the author, that has met with general approval.

As always happens, there has been a divergence of opinion between the mother country and the territory aspiring for independence. The author explains that this can be removed by the establishment of an objective and quantitative method to determine the amount of accomplishments by the natives in self-government. With the adoption of such a measuring rod, there would not be much quarrel as to the fitness of the subject countries for independence. The author forgets that due to the complex forces surrounding a colonial acquisition, it is utterly impossible to set up fixed criteria of the capacity of a subject people for independence. He admits, nevertheless, that the Indians, the Filipinos, and the Iraquis have the right to base their claims for independence on the principle of self-determination and the inalienable right of peoples to govern themselves and administer their own affairs.—F. M.

Incompatibility in Prescriptions and How to Avoid It. By Thomas Stephenson. 4th ed. rev. and enl. The Prescriber Offices, Edinburgh, 1935. 62 pp. Price, $2.

This is the fourth edition of the work which originally appeared as a series of articles in the Prescriber, collected and first published as a 32-page pamphlet in 1915. It is intended to provide a more or less complete guide to prescribing, by treating the general principles of incompatibility and giving an alphabetical list of drugs with their doses, solubilities, and incompatibilities. The book, therefore, includes valuable facts about the latter which should prove of value in prescription writing. Obviously, however, not only physicians would welcome this book, but pharmacists especially would find it of great assistance in dispensing.—B. M.

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